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ISO/TC 183/WG 1A - Determination of Gold and Silver in Copper Concentrates by Fire Assy Method
STATISTICAL EVALUATION OF INTERNATIONAL TEST DATA 1984-1986

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(For presentation at the ISO/TC 183 meeting to be held in Sydney, Australia, April 27 to May 3, 1986 and for submission to the Convener of ISO/TC 183)

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ISO/TC 183/WG 1A
DETERMINATION OF GOLD AND SILVER IN COPPER CONCENTRATES BY FIRE ASSAY METHOD
STATISTICAL EVALUATION OF INTERNATIONAL TEST DATA 1984-1986

by

R. Sutarno and W.S. Bowman

SUMMARY

The analytical data resulting from the international test on the determination of gold and silver in copper concentrate by the fire assay method, conducted by ISO/TC 183/WG 1A during the period of 1984-1986, have been statistically evaluated. Based on these analytical results, the precision of the analytical method can be expresed in terms of the gold and silver concentration level by the following equations:

Gold	Silver
r = 0.0210 x + 0.4145	r = 0.0314 x + 1.4817
P = 0.0219 x + 0.5323	P = 0.0459 x + 6.2272
sr = 0.0074 x + 0.1465	sr = 0.0111 x + 0.5236
sL = 0.0057 x + 0.1555	sL = 0.0142 x + 2.2188

where x is the Au or Ag concentration in the sample, r is the repeatability, P is the permissible tolerance, sr is the within-laboratory standard deviation and sL is the between-laboratories standard deviation all expressed in ug/g. Six samples containing Au ranging from 0.5 to 80 ug/g and Ag from 30 to 1600 ug/g were used and twenty laboratories participated in this international test. These results also show that this method has comparable precision and accuracy with the method currently under development as an alternative candidate of ISO standarnd by ISO/TC 183/WG 2A.

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ISO/TC 183/WG 1A(WG10-5)
Février 1986

ISO/TC 183/WG 1A
DETERMINATION DE LA TENEUR EN OR ET EN ARGENT DE CONCENTRÉS DE CUIVRE PAR LA MÉTHODE D'ESSAI PYROGNOSTIQUE ÉVALUATION STATISTIQUE DES DONNÉES D'UN ESSAI INTERNATIONNAL 1984-1986

par

R. Sutarno* et W.S. Bowman**

RÉSUMÉ

Les données analytiques qui ont résulté d'un essai international visant à déterminer la teneur en or et en argent de concentrés de cuivre par la méthode d'essai pyrognostique, effectué par le groupe ISO/TC 183/WG 1A au cours de la période allant de 1984 à 1986, ont été évaluées statistiquement. Selon les résultats d'analyse, la précision de la méthode analytique peut être exprimée en fonction du niveau de concentration de la teneur en or et en argent par les équations suivantes:

Or	Argent
r = 0,0210 x + 0,4145	r = 0,0314 x + 1,4817
P = 0,0219 x + 0,5323	P = 0,0459 x + 6,2272
sr = 0,0074 x + 0,1465	sr = 0,0111 x + 0,5236
sL = 0,0057 x + 0,1555	sL = 0,0142 x + 2,2188

où x est la concentration de Au ou Ag contenu dans l'échantillon, r est la répétabilité, P est la limite admissible, sr est l'écart type intralaboratoires et sL est l'écart type interlaboratoires exprimés en µg/g. Six échantillons contenant une teneur en Au allant de 0,5 à 80 µg/g et en Ag allant de 30 à 1 600 µg/g ont été utilisés pour fin d'essai, et vingt-deux laboratoires ont participé à cet essai international. Ces résultats indiquent aussi que la précision et l'exactitude de cette méthode sont comparables à celles de la méthode mise au point actuellement par le groupe ISO/TC 183/WG 2A en tant que méthode alternative à la norme de l'ISO.

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INTRODUCTION

The analytical data were collected by the convener of ISO/TC 183/WG 1A (ISO Technical Committee 183 - Copper, Lead and Zinc Ores and Concentrates, Working Group 1A - Gold and Silver on Copper Concentrates) from an international test conducted during the period of 1984-1986. Six samples of concentrates with gold contents ranging from 0.5 to 80 ug/g and silver from 30 to 1600 ug/g were used. Twenty laboratories provided analytical data; each analysed the samples in triplicate.

The purpose of this statistical evaluation is to provide the working group with the preliminary estimates of the precision in the form of repeatability, permissible tolerance, within-laboratory and between-laboratories standard deviations.

PRICIPLE OF THE ANALYTICAL METHOD (1)

Fire assaying for the determination of gold and silver comprises a series of steps. The first step is separation of the precious metals from most of the associated metals, followed by separation of gold from silver and other metals preconcentrated into a precious metal alloy.

The stages which comprise the determinations are as follows:

(a) Crucible fusion of the sample mixed with a litharge-based flux, during which,under reducing conditions, the precious metals collected in a metallic lead button.

(b) Cupellation, in which the base metals present in the lead button are separated from the precious metals. This cupellation produces a bead largely comprising silver-gold alloy with small quantities of other metals.

(c) Parting of the precious metal alloy by nitric acid to dissolve metals other than gold in the bead.

(d) Reassaying of all residues to maximize the recovery of gold and silver.

STATISTICAL EVALUATION

The analytical data collected were analysed statistically by the procedure described in document ISO/TC 102/TCR 5 (2). Because each participating laboratory analysed only one bottle of each sample, as required by WG stage A, the two-way analysis of variance (ANOVA) part of the procedure was by-passed. No confirmation of sample homogeneity was made; thus the between laboratories variance may include, if any, the between-bottles variation of the sample. This procedure is illustrated schematically in Figure 1.

The raw data and the detailed calculations are presented in Appendix A. They are summarized in Tables 1 and 2. The raw data are also plotted in Figures 2. The boxed points in these figures signify that the data were suspected to be outliers and were excluded from the estimation of the sample means and precisions. The letter C on the boxed points signifies that the data were suspected to be outliers due to poor precision (Cochran's test) and the letter D signifies outliers due to the deviation

from the sample means (Dixon's test).

The precisions estimated (sr, sL, r and P) are plotted against their corresponding sample means in Figure 3, and the regression equations of these precisions against sample means were computed and presented in Table 1. Table 2 lists the suspected outliers.

OBSERVATIONS

An ideal standard analytical method is an analytical method that can be applied by any qualified analyst with proper equipment and reagents with equal precision and accuracy. This implies that the better the method is standardized the smaller is the sL/sr ratio and the fewer the number of outliers. The magnitude of within-laboratory standard deviation itself depends on the state of the art of the method. Experience from another Technical Committee dealing with mineral analyses (iron ores) shows that for a good method, the average sL/sr ratio is found to be about 2. Table 1 shows that the magnitude of the within-laboratory preci-sion seems to be reasonable. Using sL/sr ratio of 2 as a bench mark, the observed sL/sr ratios for both gold and silver determi-nation are acceptable. Tables 2 show that although the number of suspected outliers is acceptable, some laboratories seem to have difficulty in applying the method. Table 3 shows that both the grand means and precision of the silver results obtained by this method are comparable with those obtained by WG 2A (3). Statistical test of the difference between these grand means show insignificant results (Table 4). Table 5 shows that that there is no systematic difference between the precision of the two methods.

REFERENCES

1. "Copper Concentrates - Determination of gold and silver by fire assay", ISO/TC 183(WG1A-4), May 1985.

2. "Procedure for statistical evaluation of analytical data resulting from international tests", ISO/TC 102/TCR 5, 1985-06-11.

3. "ISO/TC 183/WG 2A-Determination of silver in copper concentrates-Statistical evaluation of international test data 1984-1986" R. Sutarno and W.S. Bowman, ISO/TC 183/WG 2A(WG10-2), January 1986, CANMET,Energy,Mines and Resources Canada; Division Report MSL 86-6(IR), 1986.

Abbreviations Used in this Report

s_r = SIGMA-R - within laboratory standard deviation

s_L = SIGMA-L - between laboratories standard deviation

r^* = R - repeatability

= 2.83 s_r

p^{**} = permissible tolerance between laboratories

$$= 2.83\left(s_L^2 + s_r^2/2\right)^{\frac{1}{2}}$$

* Repeatability, r, is the value below which the absolute difference between two independent single test (analysis) results produced by a laboratory on identical material using the same equipment within a short interval of time, using the standardized test method, may be expected to be with a 95% probability.

** Permissible tolerance between laboratories, P, is the value below which the absolute difference between two means of duplicate test results on identical material obtained by operators of different laboratories using the standardized test method, may be expected to lie with a 95% probability.

KO - total number of participating laboratories

K - number of sets of laboratory results used for ANOVA

NO - total number of analytical results

N - No. of analytical results used for ANOVA

Table 1.Au

ISO/TC 183/WG 1A/WG 1A-3 AU AND AG IN COPPER CONC. BY FIRE ASSAY - GOLD

SUMMARY OF PRECISIONS FOR ALL SAMPLES

ELEMENT	SAMPLE	KO	K	NO	N	MEAN(X)	REPEATABILITY	PERMISSIBLE TOLERANCE	SIGMA-R	SIGMA-L	SIGMA-L/SIGMA-R
GOLD	85-1	20	20	60	60	31.3773	1.5927	2.0014	.56279	.58462	1.04
GOLD	85-2	20	17	60	51	11.2961	.7138	.8105	.25222	.22407	.89
GOLD	85-3	20	19	60	57	76.9732	1.8015	1.9029	.63658	.49951	.78
GOLD	85-4	20	18	60	54	.7080	.3262	.4338	.11527	.12983	1.13
GOLD	85-5	19	19	56	56	8.6982	.6592	.6526	.23294	.16141	.69
GOLD	85-11	18	17	54	51	.4675	.1071	.2250	.03786	.07488	1.98

THE REGRESSION EQUATIONS ARE:

					CORR. COEFF.
R	=	.0210 X	+	.4145	.9006
P	=	.0219 X	+	.5323	.8445
SIGMA-R	=	.0074 X	+	.1465	.9006
SIGMA-L	=	.0057 X	+	.1555	.7968

Table 1.Ag

ISO/TC 183/WG 1A/WG 1A-3 AU AND AG IN COPPER CONC. BY FIRE ASSAY - SILVER

SUMMARY OF PRECISIONS FOR ALL SAMPLES

ELEMENT	SAMPLE	KO	K	NO	N	MEAN(X)	REPEATABILITY	PERMISSIBLE TOLERANCE	SIGMA-R	SIGMA-L	SIGMA-L/SIGMA-R
SILVER	85-5	16	15	45	44	29.1932	3.0878	6.1868	1.09111	2.04549	1.87
SILVER	85-1	17	15	49	43	76.6698	4.2901	6.1526	1.51593	1.89143	1.25
SILVER	85-4	17	15	51	45	140.0422	5.7553	13.8639	2.03366	4.68309	2.30
SILVER	85-2	17	15	51	45	180.2111	8.2164	12.0131	2.90333	3.71546	1.28
SILVER	85-3	15	15	44	44	554.5886	15.9329	40.7352	5.62998	13.83259	2.46
SILVER	85-11	14	13	42	39	1562.9744	51.4305	75.0630	18.17333	23.20322	1.28

THE REGRESSION EQUATIONS ARE:

			CORR. COEFF.
R	=	.0314 X + 1.4817	.9967
P	=	.0459 X + 6.2272	.9849
SIGMA-R	=	.0111 X + .5236	.9967
SIGMA-L	=	.0142 X + 2.2188	.9736

Table 2.Au

ISO/TC 183/WG 1A/WG 1A-3 AU AND AG IN COPPER CONC. BY FIRE ASSAY - GOLD

LIST OF OUTLIERS

ELEMENT	SAMPLE	COCHRAN (PRECISION)	DIXON (ACCURACY)	LAB HAS ONLY ONE RESULT	INDIVIDUAL OUTLYING RESULT (DIXON)
GOLD	85-1	-	-	-	-
GOLD	85-2	LAB 2 LAB 9	LAB13 -	- -	- -
GOLD	85-3	LAB30	-	-	-
GOLD	85-4	LAB30	LAB32	-	-
GOLD	85-5	-	-	-	-
GOLD	85-11	LAB30	-	-	-

Table 2.Ag

ISO/TC 183/WG 1A/WG 1A-3 AU AND AG IN COPPER CONC. BY FIRE ASSAY - SILVER

LIST OF OUTLIERS

ELEMENT	SAMPLE	COCHRAN (PRECISION)	DIXON (ACCURACY)	LAB HAS ONLY ONE RESULT	INDIVIDUAL OUTLYING RESULT (DIXON)
SILVER	85-5	-	-	LAB 3	-
SILVER	85-1	LAB 2	-	-	-
		LAB 3	-	-	-
SILVER	85-4	LAB 7	-	-	-
		LAB 9	-	-	-
SILVER	85-2	LAB14	LAB 8	-	-
SILVER	85-3	-	-	-	-
SILVER	85-11	LAB 8	-	-	-

Table 3.

ISO/TC183/WG1A - SILVER (us/s)

COMPARISON BETWEEN SAMPLE GRAND MEANS AND PRECISION OBTAINED BY WG1A AND WG 2A

SAMPLE	XBAR			R			P			sr			sL		
No	WG1A	WG2A	1A/2A	WG1A	WG2A	1A/2A	WG1A	WG2A	1A/2A	WG1A	WG2A	1A/2A	WG1A	WG2A	1A/2A
85-5	28.18	28.44	1.03	3.09	3.73	0.83	6.18	6.28	0.98	1.09	1.32	0.83	2.05	2.02	1.01
85-1	76.87	76.87	1.00	4.29	5.10	0.84	6.15	10.12	0.61	1.52	1.80	0.84	1.89	3.34	0.57
85-4	140.04	141.50	0.99	5.78	4.50	1.28	13.86	11.82	1.18	2.03	1.59	1.18	4.68	3.95	1.18
85-2	180.21	179.68	1.00	8.22	2.44	3.37	12.01	10.89	1.10	2.90	.86	3.37	3.72	3.80	0.98
85-3	554.58	557.03	1.00	15.83	9.34	1.71	40.74	27.22	1.50	5.63	3.30	1.71	13.83	9.33	1.48
85-11	1562.87	1566.01	1.00	51.43	40.40	1.27	75.06	77.54	0.97	18.17	14.27	1.27	23.20	25.47	0.91

Table 4

ISO/TC 183/WG 1A & WG 2A - Silver
Silver in Copper Concentrates - Fire assay Method
Statistical test for the difference between sample grand means obtained by Wg1A and WG2A

Sample No	WG1A x1 ug/g	WG2A x2 ug/g	|x1 - x2| ug/g	V[x1] ug/g**2	V[x2] ug/g**2	Sd ug/g	T*
85-5	29.19	28.44	0.75	0.308	0.310	0.79	0.95
85-1	76.67	76.97	0.30	0.295	0.721	1.01	0.30
85-4	140.04	141.50	1.44	1.554	1.096	1.63	0.88
85-2	180.21	179.68	0.53	1.108	1.130	1.50	0.35
85-3	554.59	557.03	2.44	13.569	6.046	4.43	0.55
85-11	1562.97	1566.01	3.04	49.883	51.192	10.05	0.30

x1 - Sample grand mean obtained by WG1A
x2 - Sample grand mean obtained by WG2A
V[x1]- Variance of x1
V[x2]- Variance of x2

Sd = {V[x1] + V[x2]}**0.5

T = |x1 - x2|/Sd
* The difference between x1 and x2 is statistically significant when T is greater than 2.

Table 5

ISO/TC 183/WG 1A & WG 2A - Silver
Silver in Copper Concentrates - Fire assay Method
Statistical test for the ratio of precision
obtained by WG1A and WG2A

Sample	Within-Lab. Var.						Between-Lab. Mean Squares					
No	V1	f1	V2	f2	Fc	*	MS1	f1	MS2	f2	Fc	*
85-5	1.19	29	1.74	30	0.68	I	13.46	14	13.96	14	0.96	I
85-1	2.30	28	3.24	34	0.71	I	12.54	14	36.77	16	0.34	S
85-4	4.14	30	2.53	30	1.64	I	69.93	14	49.32	14	1.42	I
85-2	8.43	30	0.75	26	11.24	S	49.84	14	44.06	12	1.13	I
85-3	31.70	29	10.89	30	2.91	S	592.67	14	272.05	14	2.18	I
85-11	330.27	26	203.77	28	1.62	I	1945.44	12	2150.07	13	0.90	I

V1 - Within-Lab. variance obtained by WG1A
V2 - Within-Lab. variance obtained by WG2A
MS1 - Between-Lab. mean squares obtained by WG1A
MS2 - Between-Lab. mean squares obtained by WG2A
f1 - Gegrees of freedom associated with V1 or MS1
f2 - Degrees of freedom associated with V2 or MS2
Fc - Ratio of either within-lab. variance or between-lab. mean squares obtained by WG1A and WG2A
S - There is evidence that there is difference between the precision of the two methods
I - There is no evidence that there is difference between the precision of the two methods
* - Statistical tests are at 5% level of significance

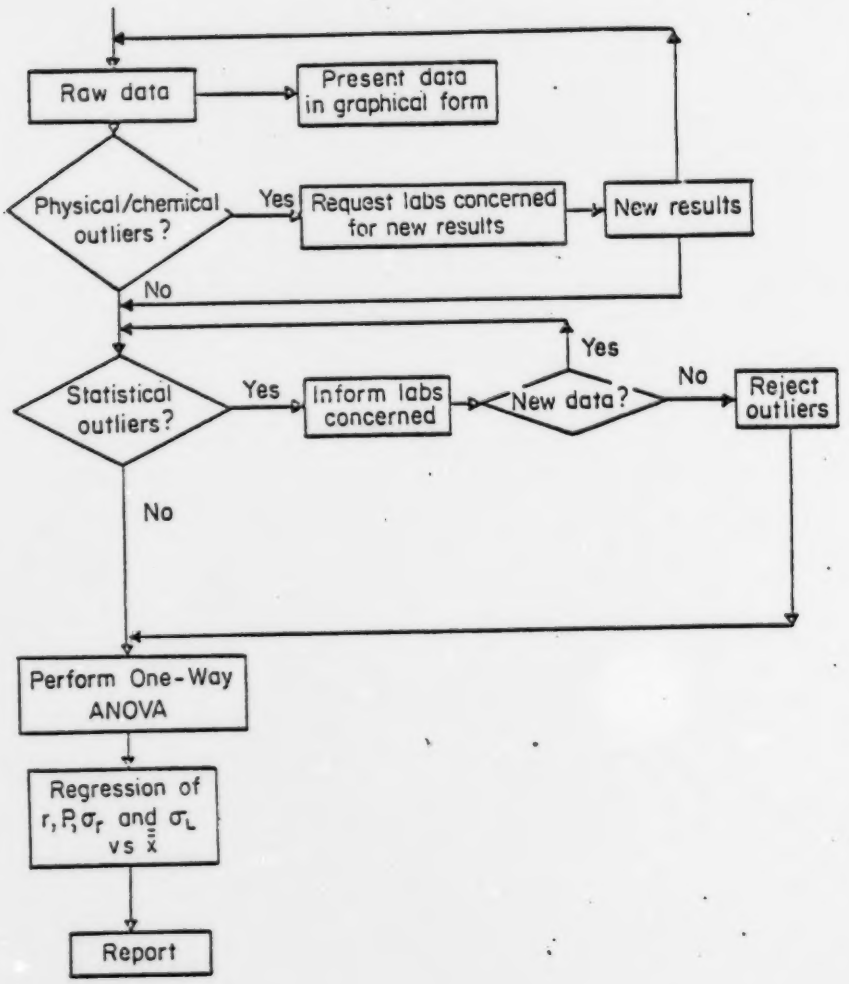

Figure 1. Flow Chart of the Procedure for Statistical Evaluation of Analytical Data Resulting from International Tests If The Test Sample is Known to be Homogeneous.

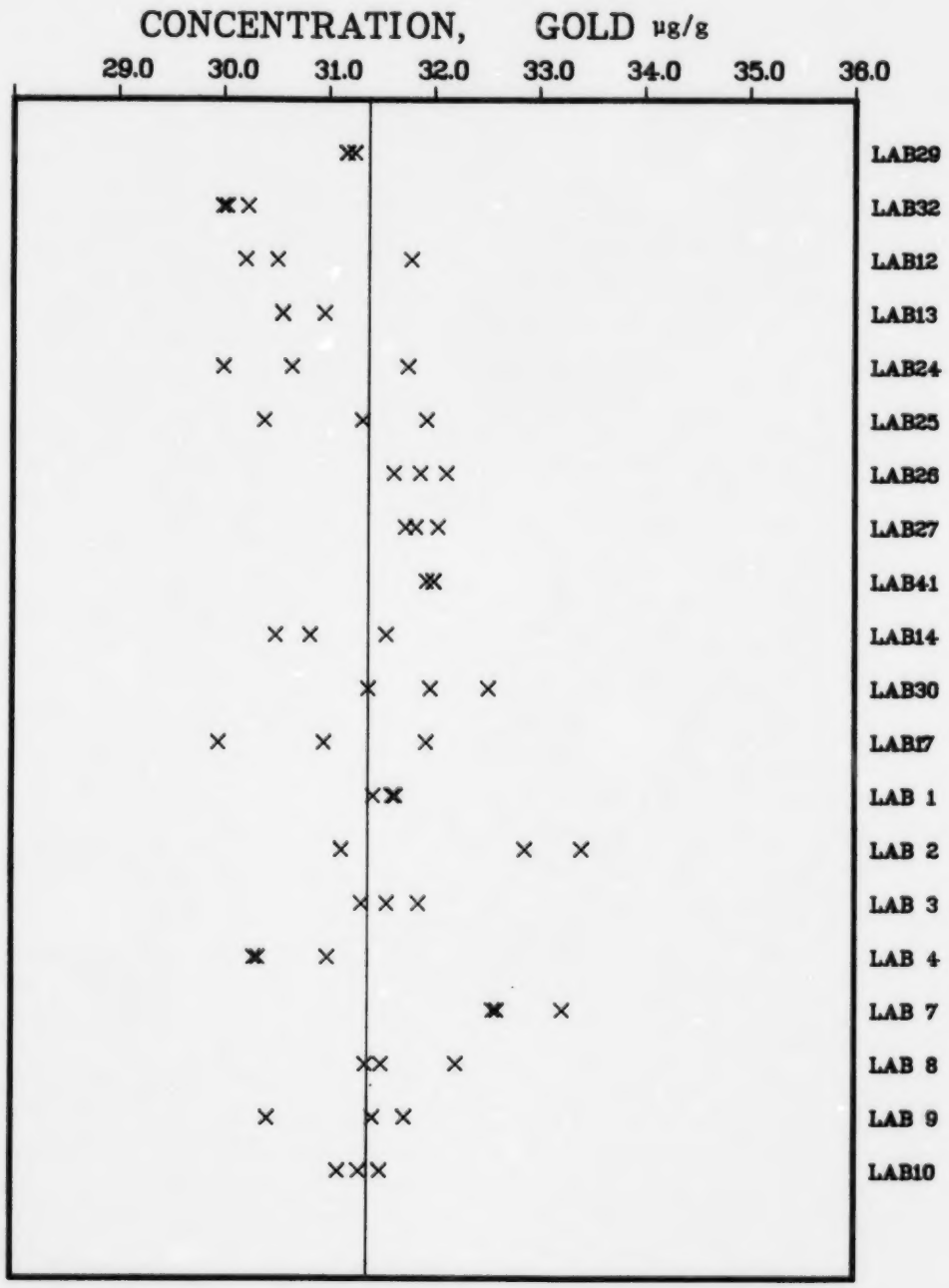

Figure 2.1.Au ISO/TC 183/WG 1A/WG 1A-3 AU AND AG IN COPPER CONC. BY FIRE ASSAY - GOLD SAMPLE: 85-1

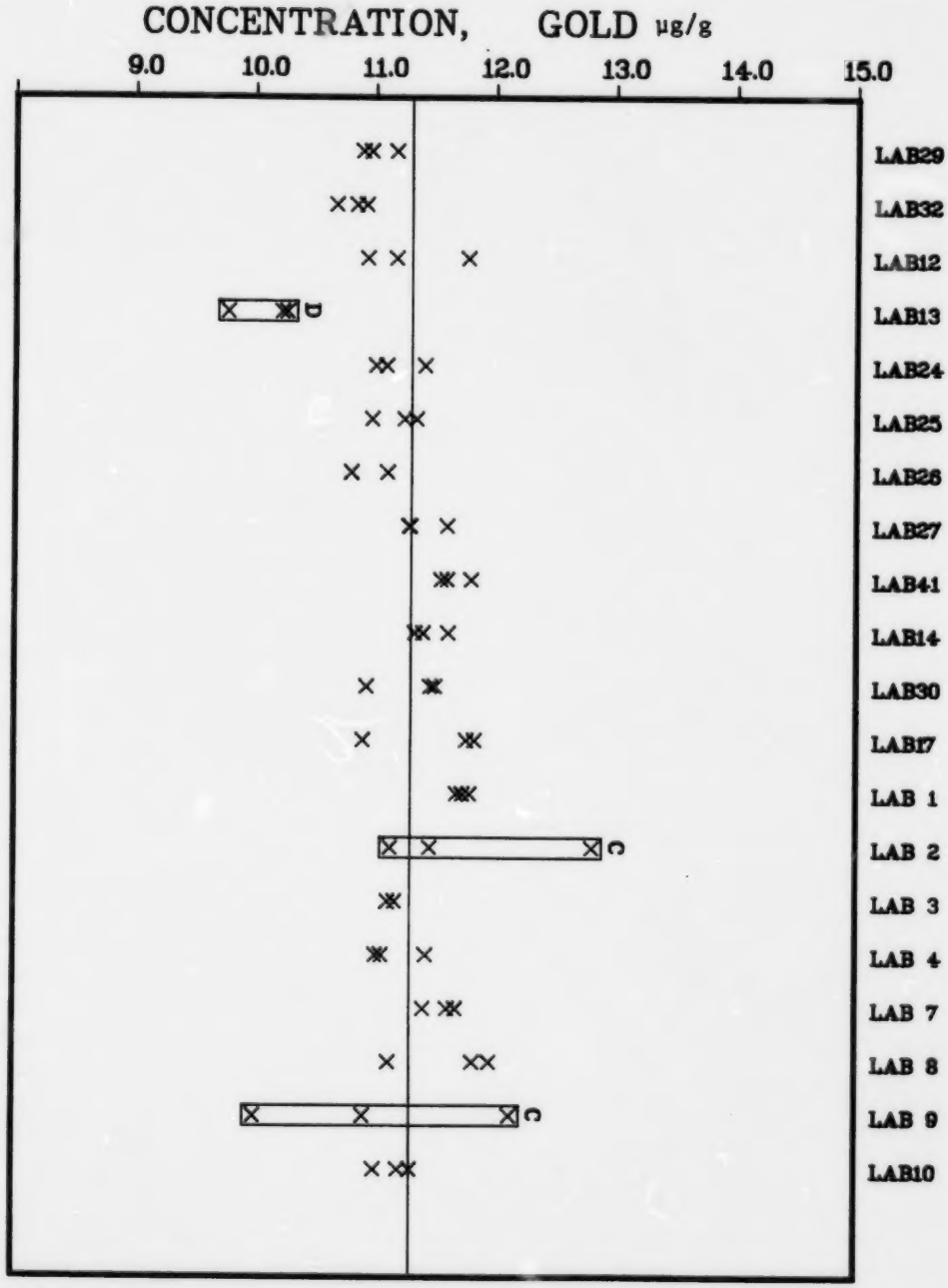

Figure 2.2.Au ISO/TC 183/WG 1A/WG 1A-3 AU AND AG IN COPPER CONC. BY FIRE ASSAY - GOLD
SAMPLE: 85-2

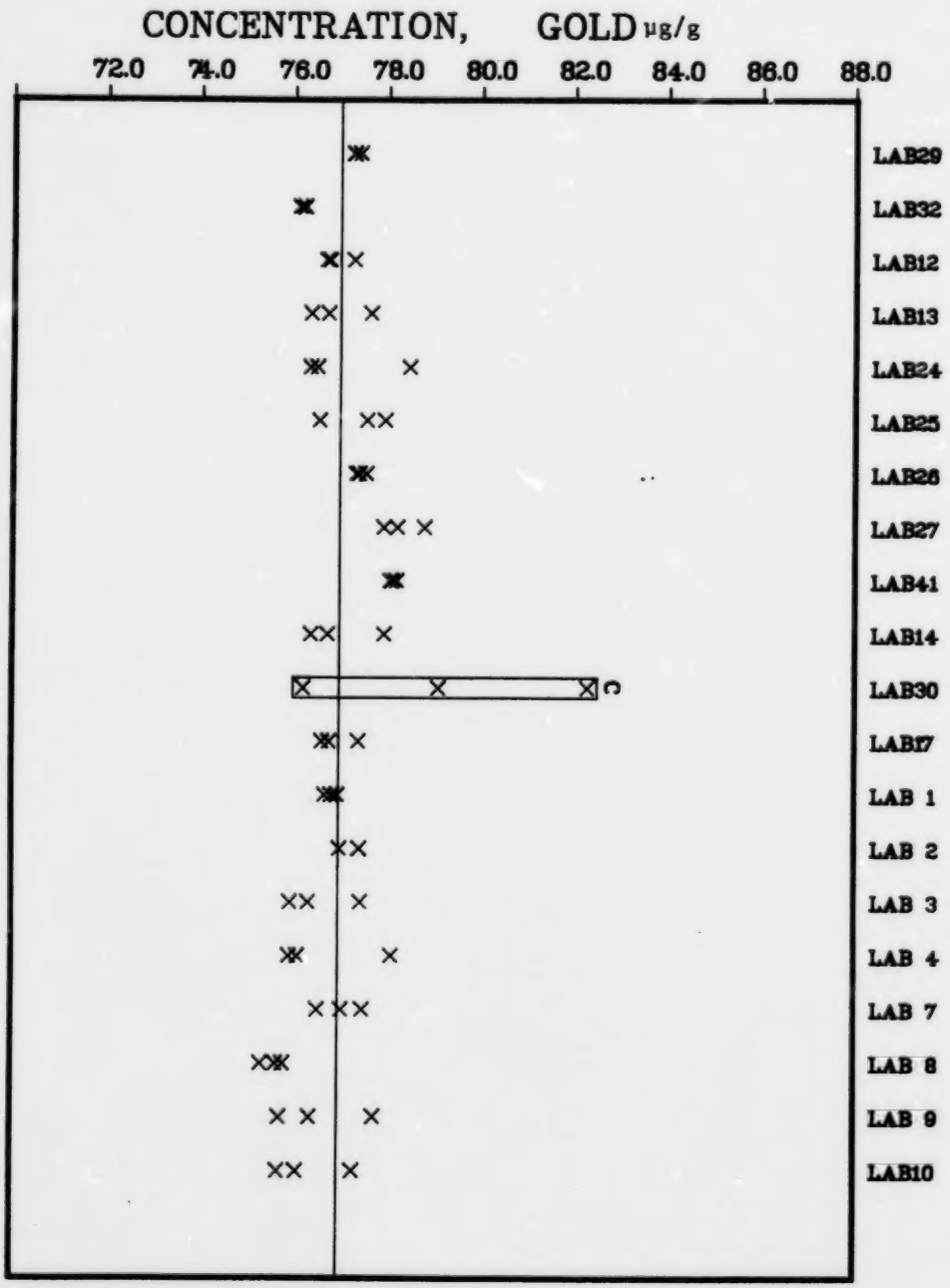

Figure 2.3.Au ISO/TC 183/WG 1A/WG 1A-3 AU AND AG IN COPPER CONC. BY FIRE ASSAY - GOLD

SAMPLE: 85-3

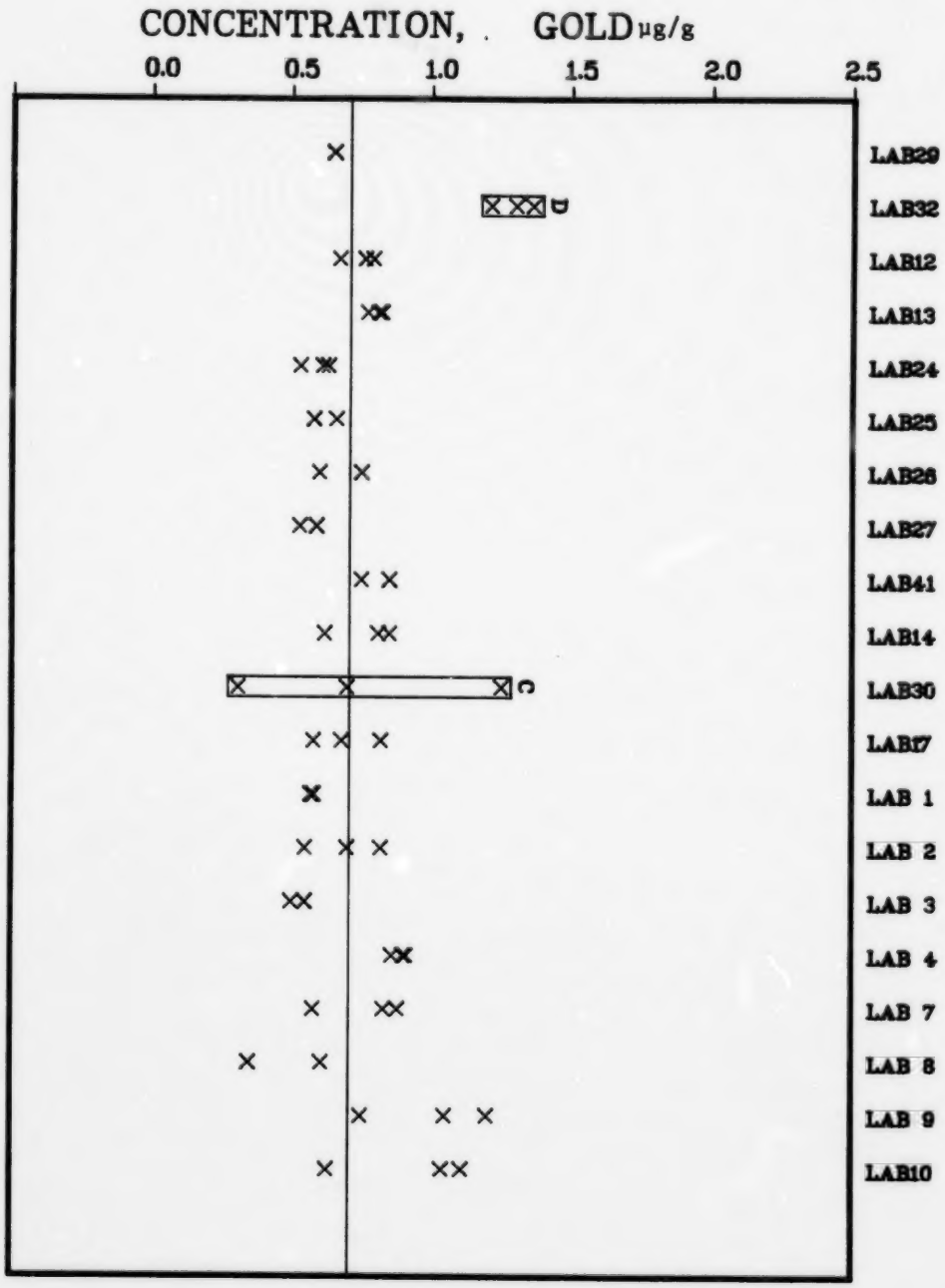

Figure 2.4.Au ISO/TC 183/WG 1A/WG 1A-3 AU AND AG IN COPPER CONC. BY FIRE ASSAY - GOLD
SAMPLE: 85-4

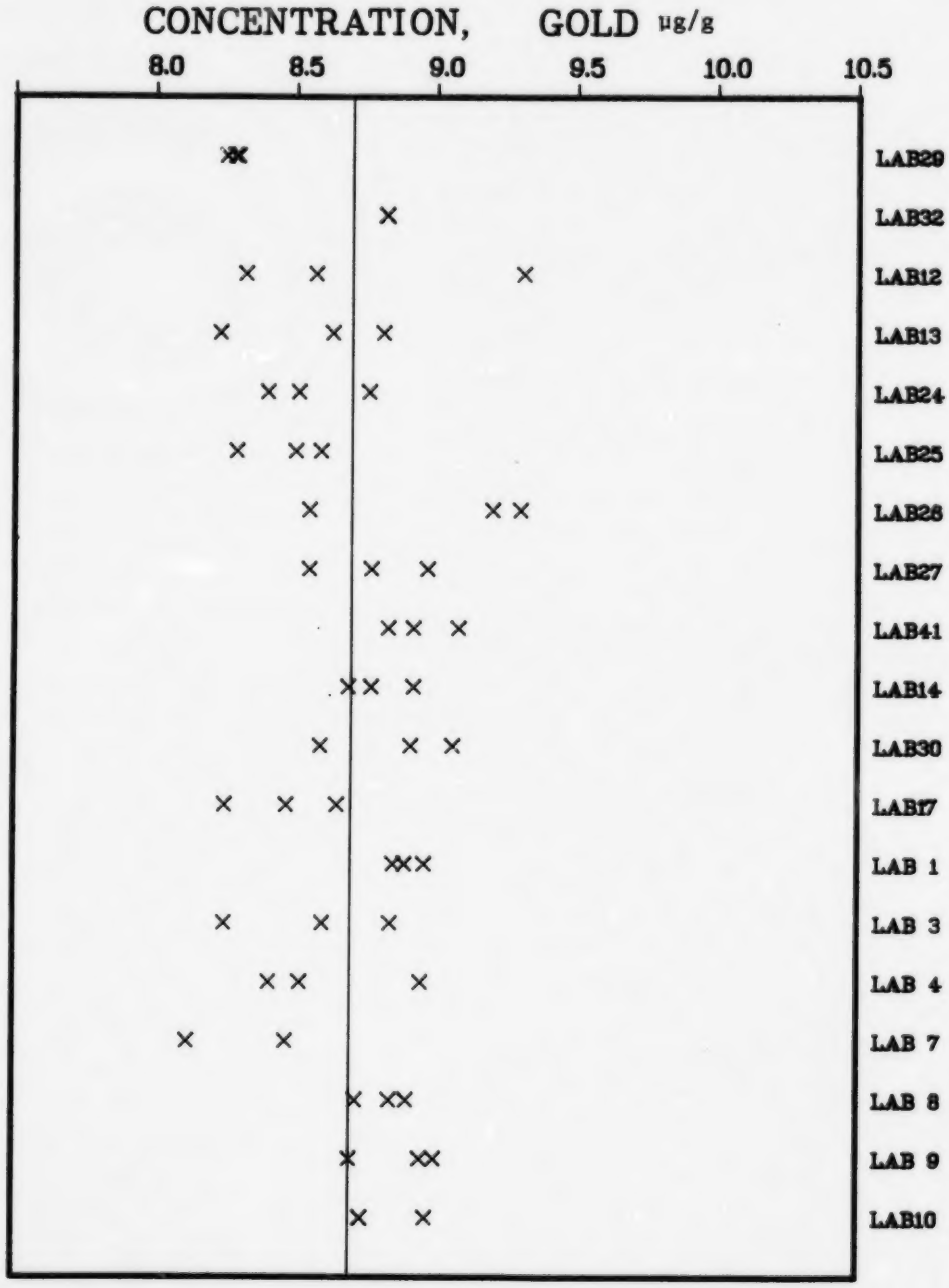

Figure 2.5.Au ISO/TC 183/WG 1A/WG 1A-3 AU AND AG IN COPPER CONC. BY FIRE ASSAY - GOLD
SAMPLE: 85-5

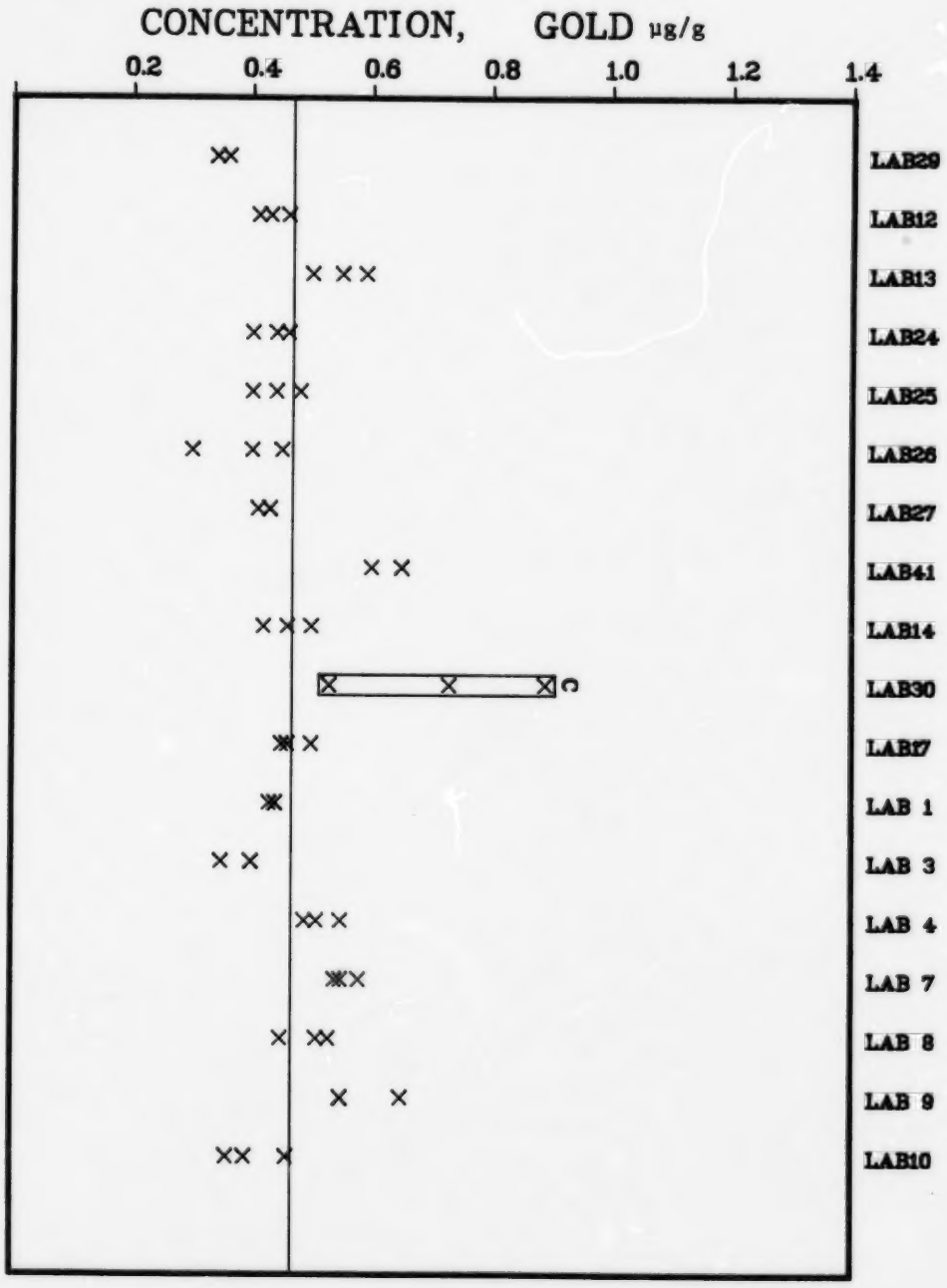

Figure 2.6.Au ISO/TC 183/WG 1A/WG 1A-3 AU AND AG IN COPPER CONC. BY FIRE ASSAY - GOLD
SAMPLE: 85-11

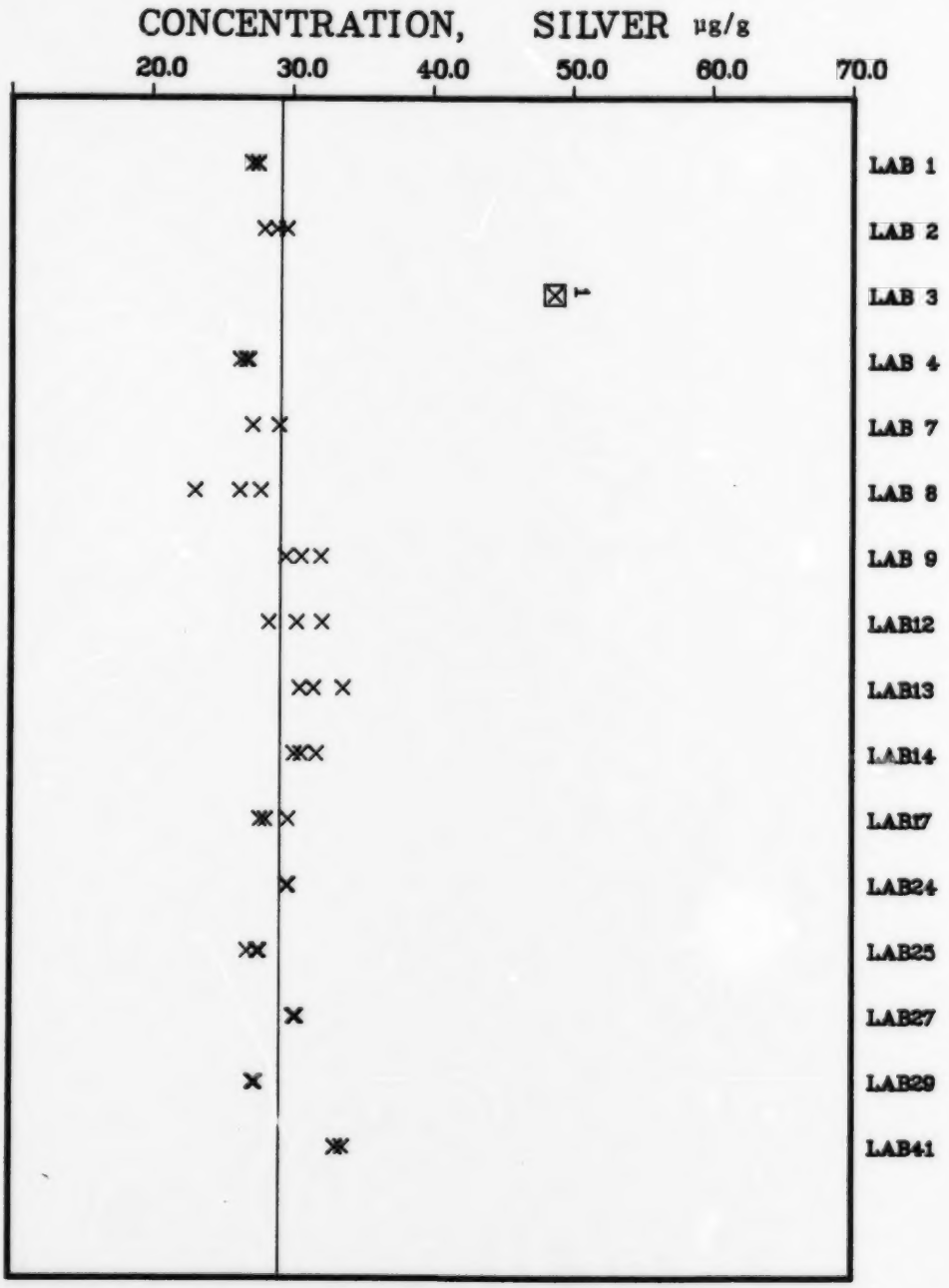

Figure 2.1.Ag ISO/TC 183/WG 1A/WG 1A-3 AU AND AG IN COPPER CONC. BY FIRE ASSAY - SILVER
SAMPLE: 85-5

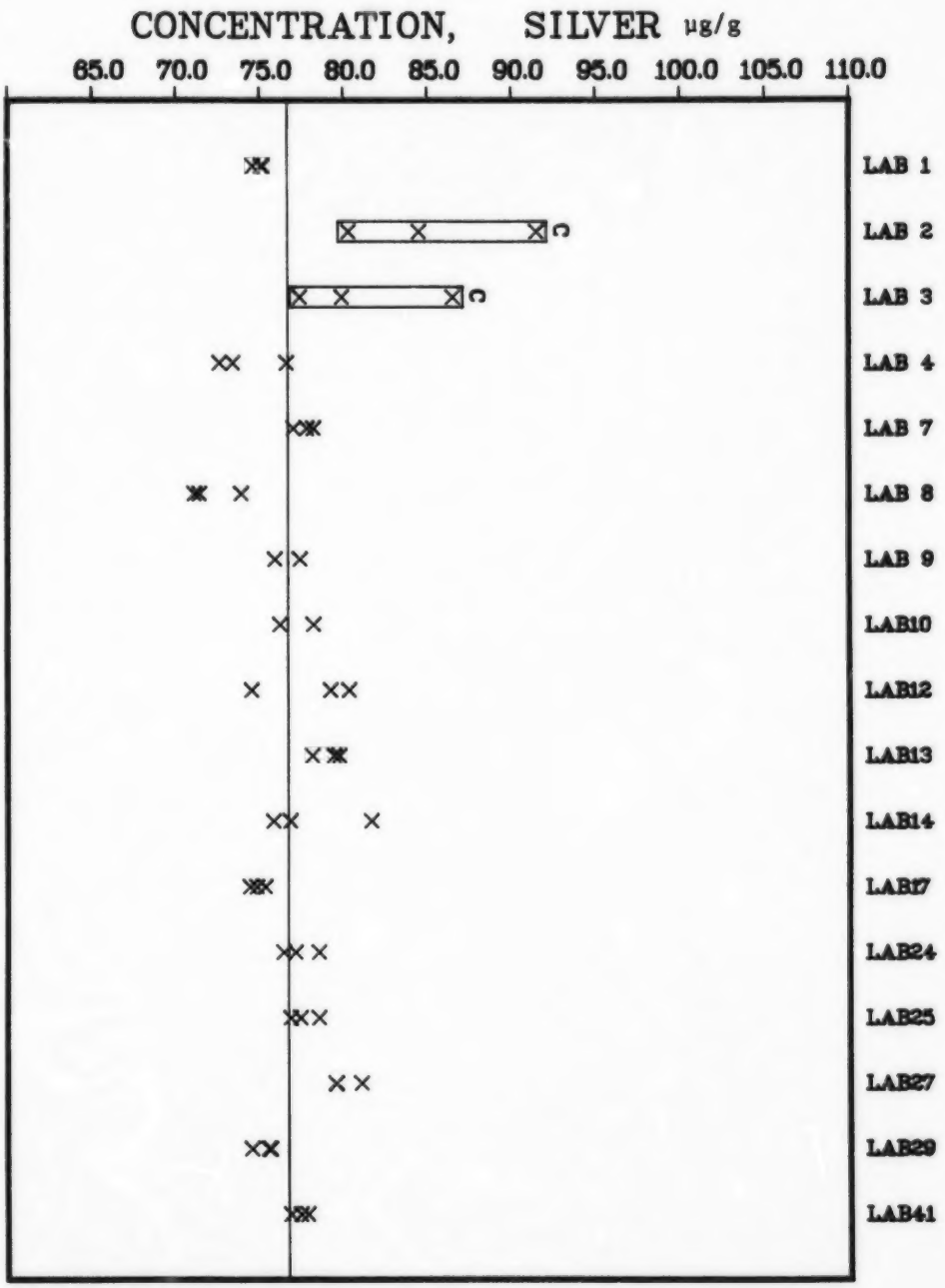

Figure 2.2.Ag ISO/TC 183/WG 1A/WG 1A-3 AU AND AG IN COPPER CONC. BY FIRE ASSAY - SILVER
SAMPLE: 85-1

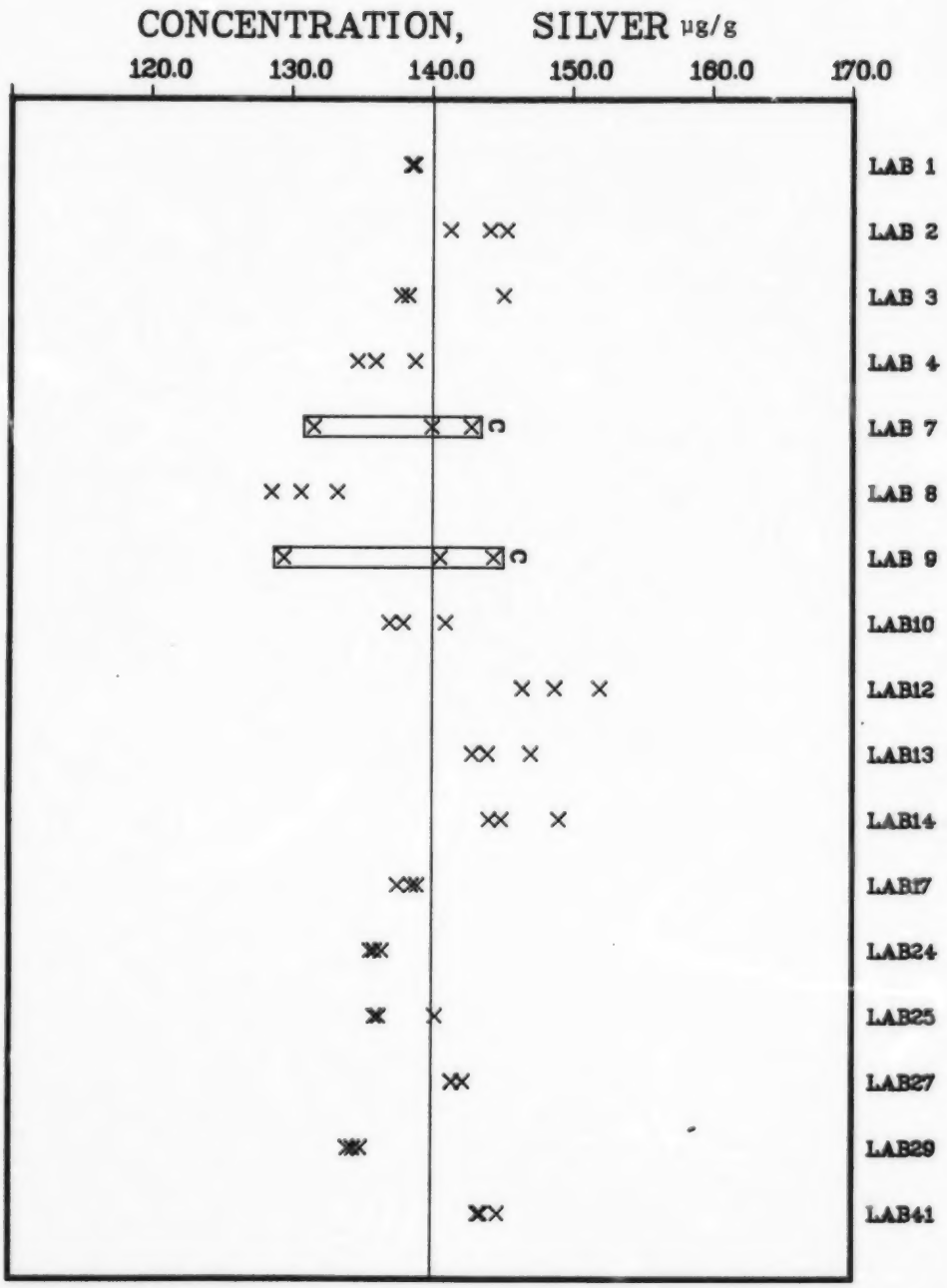

Figure 2.3.Ag ISO/TC 183/WG 1A/WG 1A-3 AU AND AG IN COPPER CONC. BY FIRE ASSAY - SILVER SAMPLE 85-4

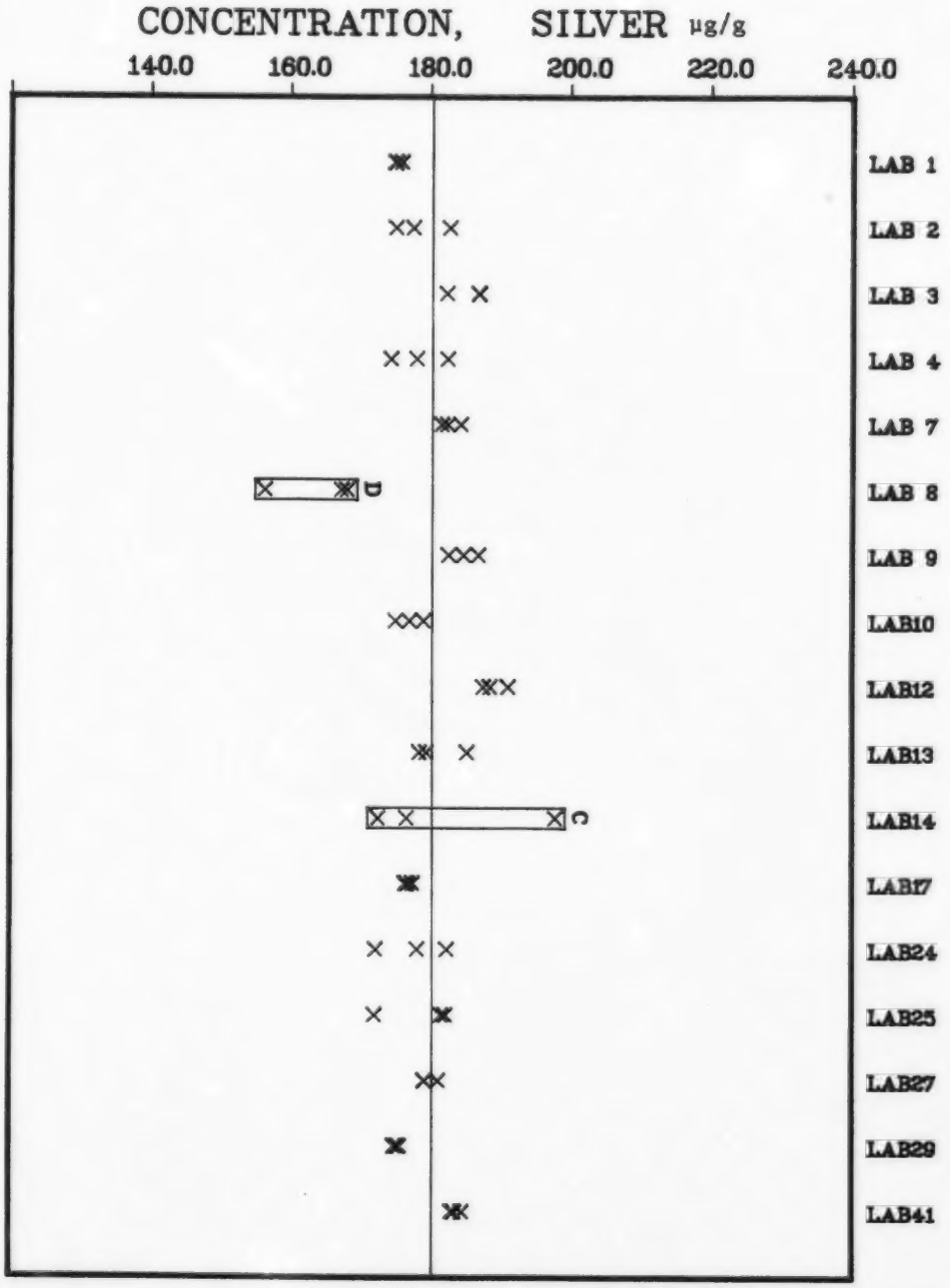

Figure 2.4.Ag ISO/TC 183/WG 1A/WG 1A-3 AU AND AG IN COPPER CONC. BY FIRE ASSAY - SILVER SAMPLE: 85-2

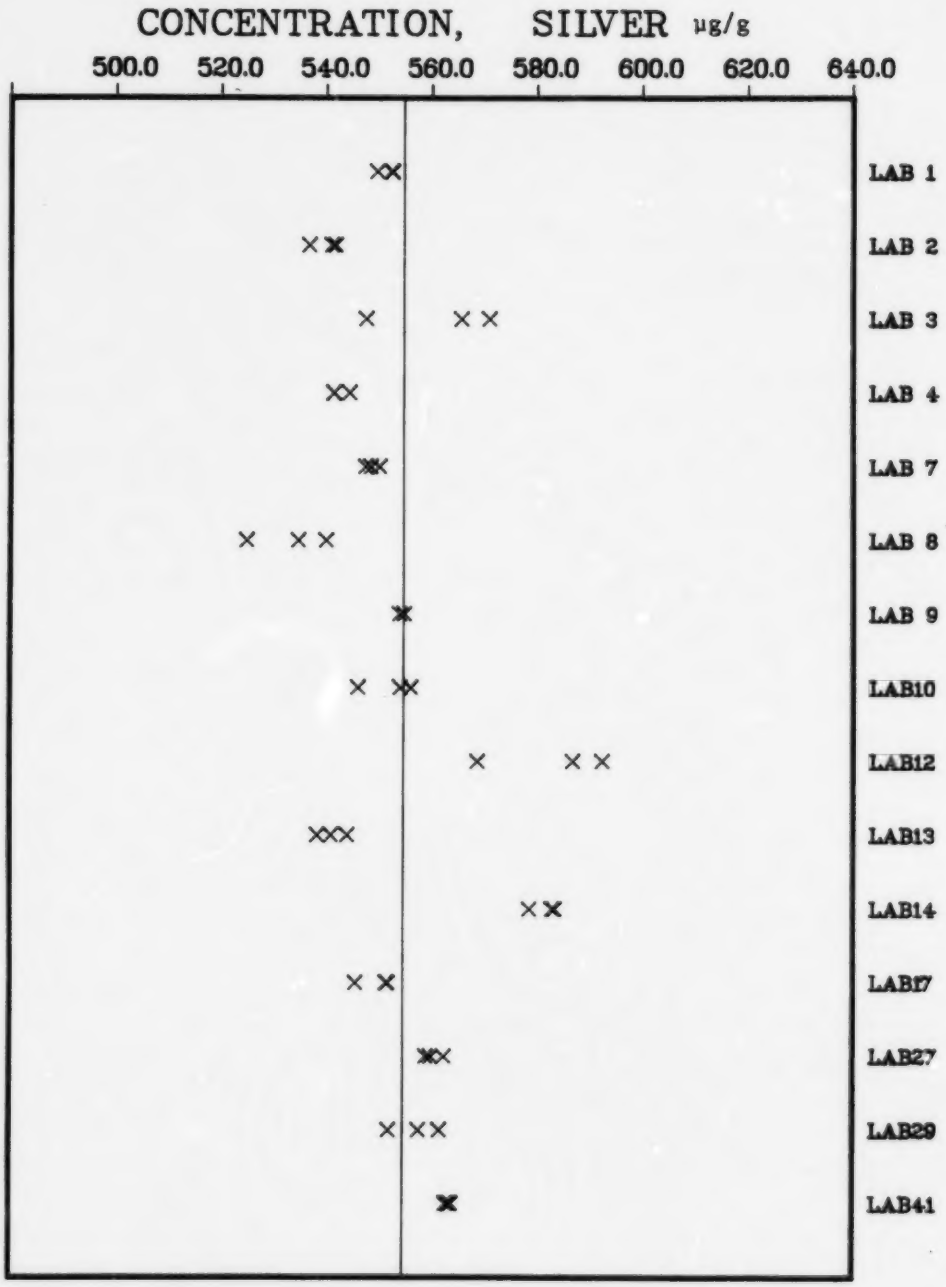

Figure 2.5.Ag ISO/TC 183/WG 1A/WG 1A-3 AU AND AG IN COPPER CONC. BY FIRE ASSAY - SILVER
SAMPLE: 85-3

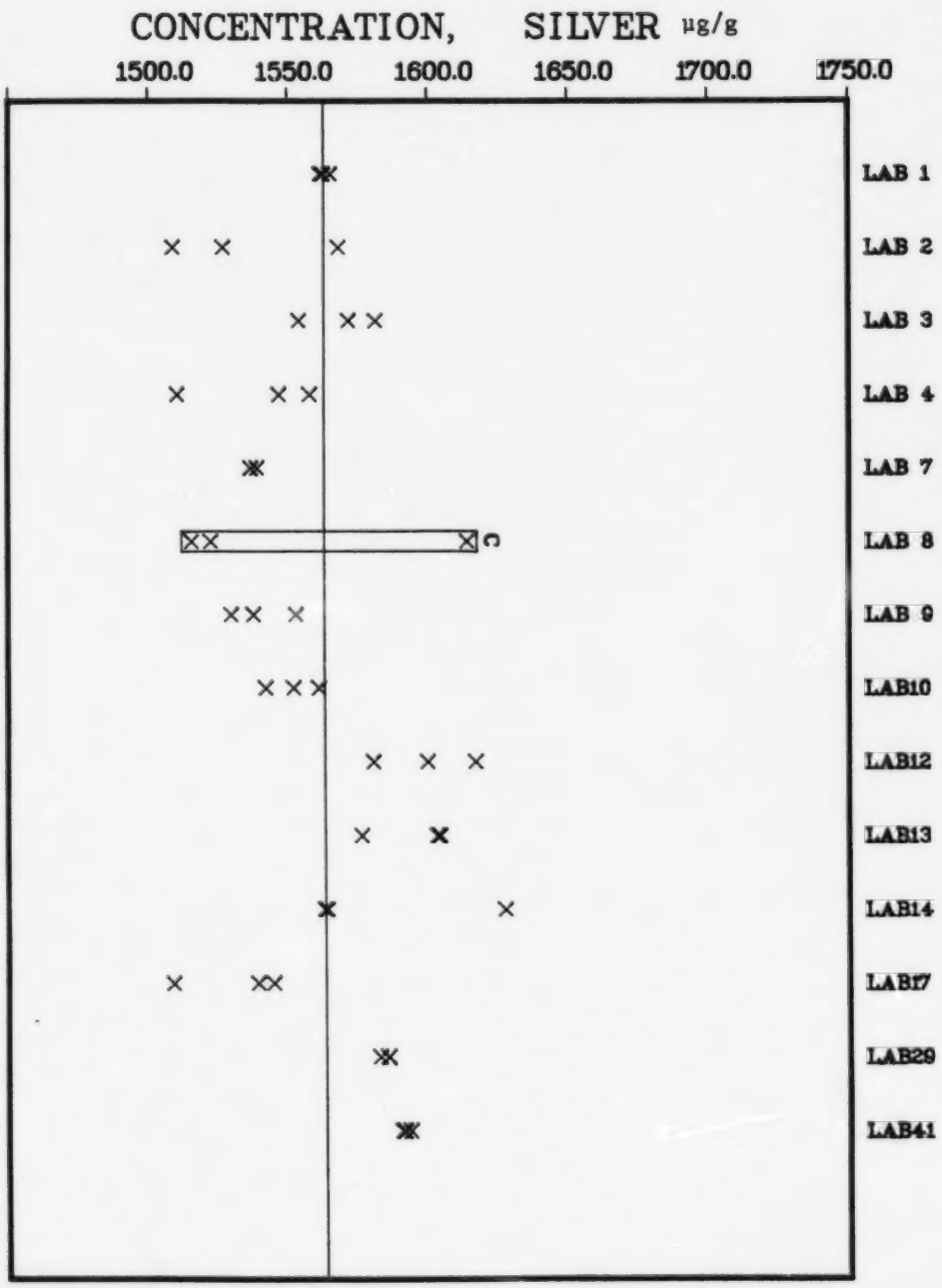

Figure 2.6.Ag ISO/TC 183/WG 1A/WG 1A-3 AU AND AG IN COPPER CONC. BY FIRE ASSAY - SILVER
SAMPLE: 85-11

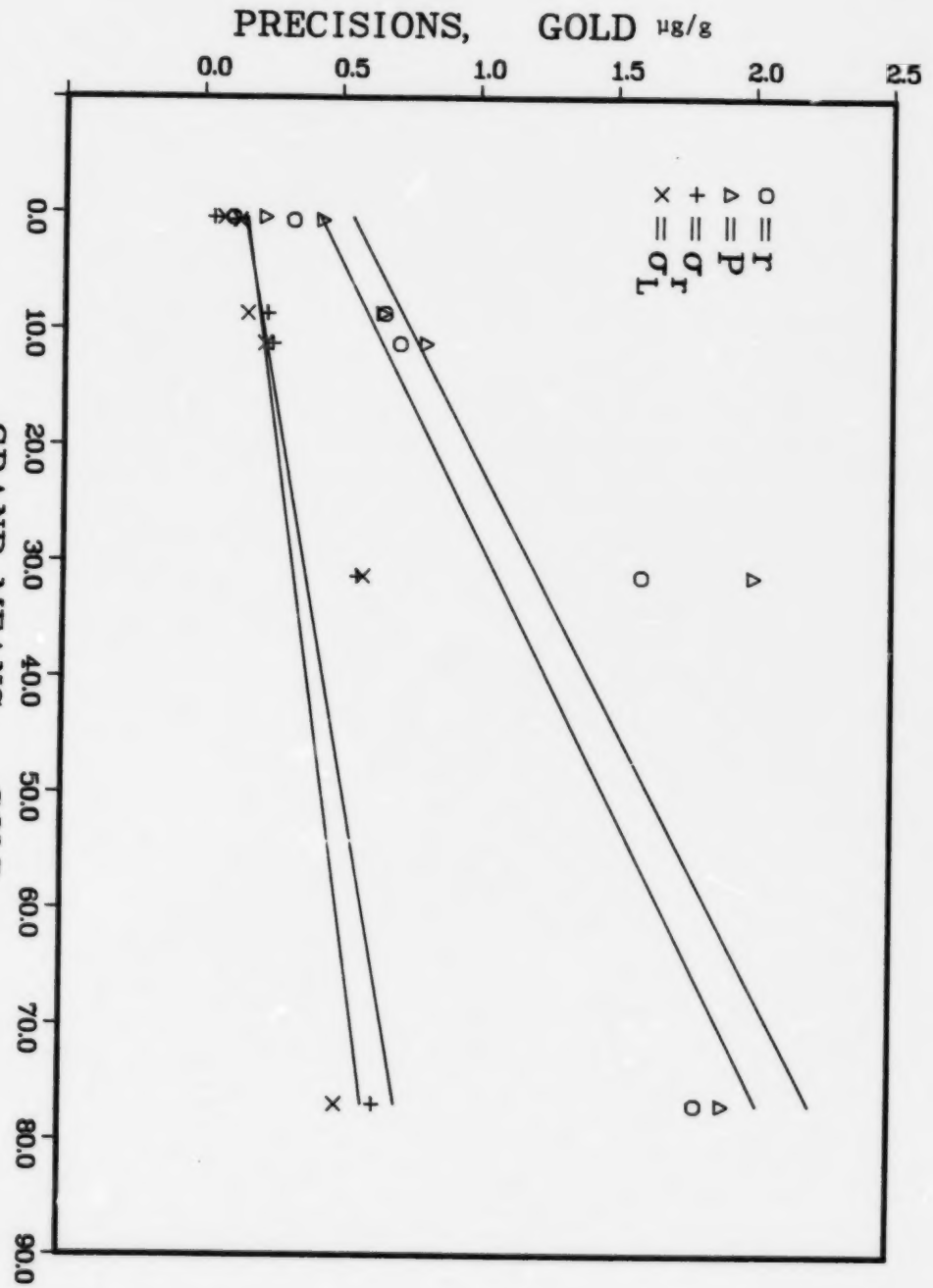

Figure 3.Au ISO/TC 183/WG 1A/WG 1A-3 AU AND AG IN COPPER CONC. BY FIRE ASSAY – GOLD

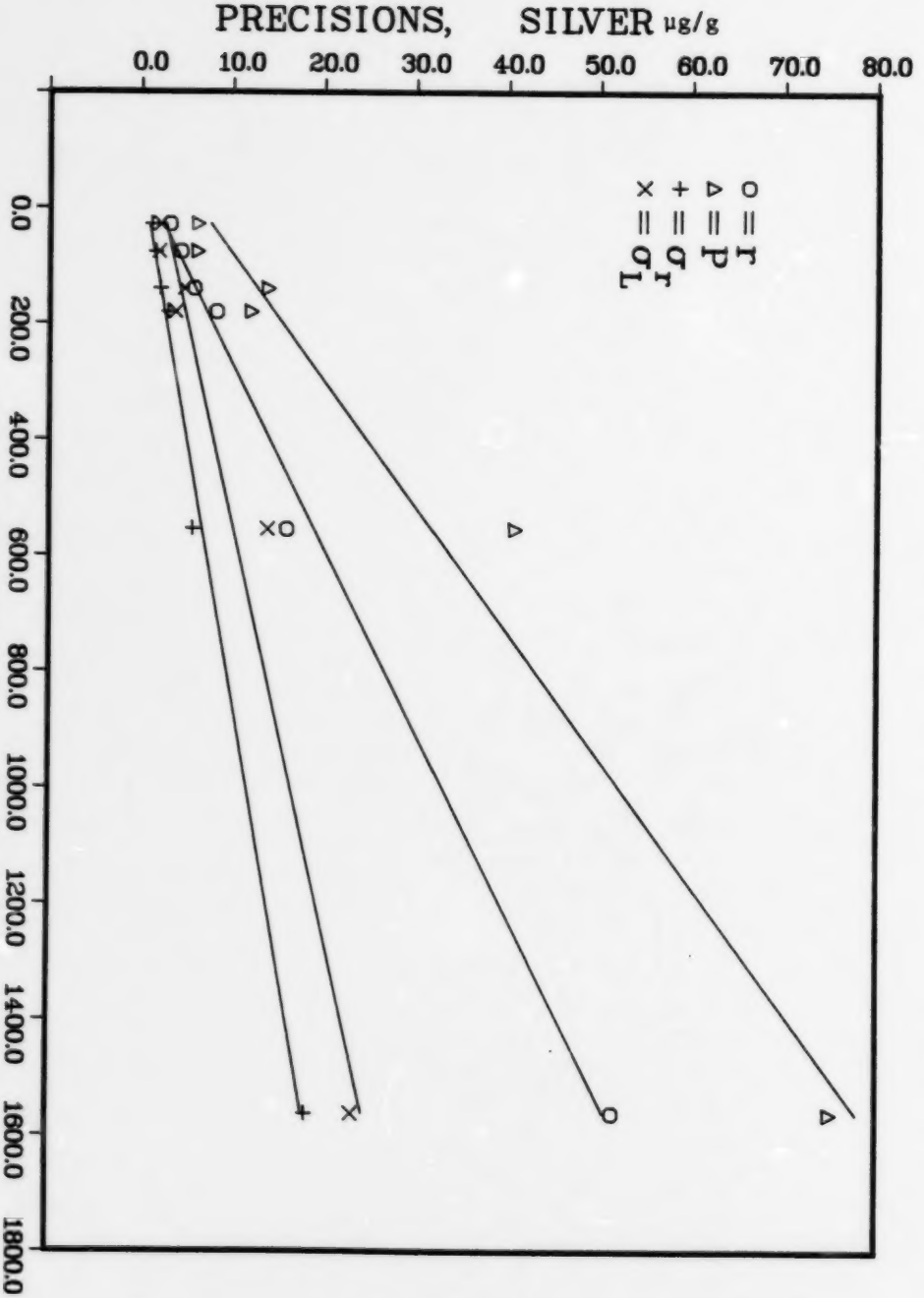

Figure 3.Ag ISO/TC 183/WG 1A/WG 1A-3 AU AND AG IN COPPER CONC. BY FIRE ASSAY – SILVER

ISO/TC183/WG1A
DETERMINATION OF GOLD AND SILVER IN COPPER CONCENTRATES BY FIRE ASSAY METHOD
STATISTICAL EVALUATION OF INTERNATIONAL TEST DATA 1984-1986

APPENDIX A. Au

DETAILED COMPUTATION OF ANALYTICAL DATA

GOLD

ISO/TC 183/WG 1A/WG 1A-3 AU AND AG IN COPPER CONC. BY FIRE ASSAY - GOLD
SAMPLE: 85-1

LABORATORY NO.	COUNTRY	BOTTLE NO.	ANALYTICAL RESULTS GOLD			LAB MEAN	LAB VARIANCE
1	LAB29	1	31.1600	31.2400	31.1700	31.19000	.1900E-02
2	LAB32	1	29.9900	30.2300	30.0300	30.08333	.1653E-01
3	LAB12	1	30.2100	31.7800	30.5100	30.83333	.6946E+00
4	LAB13	1	30.9600	30.5600	30.5600	30.69333	.5333E-01
5	LAB24	1	30.0000	30.6500	31.7500	30.80000	.7825E+00
6	LAB25	1	31.3200	31.9300	30.3900	31.21333	.6014E+00
7	LAB26	1	32.1200	31.6200	31.8700	31.87000	.6250E-01
8	LAB27	1	32.0400	31.8300	31.7300	31.86667	.2503E-01
9	LAB41	1	31.9300	32.0000	32.0000	31.97667	.1633E-02
10	LAB14	1	30.8300	31.5500	30.5000	30.96000	.2883E+00
11	LAB30	1	32.5200	31.3800	31.9700	31.95667	.3250E+00
12	LAB17	1	30.9600	31.9300	29.9600	30.95000	.9703E+00
13	LAB 1	1	31.6100	31.6400	31.4300	31.56000	.1290E-01
14	LAB 2	1	31.1300	33.4100	32.8700	32.47000	.1420E+01
15	LAB 3	1	31.5600	31.8600	31.3200	31.58000	.7320E-01
16	LAB 4	1	30.3400	31.0000	30.3000	30.54667	.1545E+00
17	LAB 7	1	32.5700	33.2300	32.6100	32.80333	.1369E+00
18	LAB 8	1	31.5100	31.3600	32.2200	31.69667	.2110E+00
19	LAB 9	1	31.4300	30.4300	31.7300	31.19667	.4633E+00
20	LAB10	1	31.1000	31.3000	31.5000	31.30000	.4000E-01

ISO/TC 183/WG 1A/WG 1A-3 AU AND AG IN COPPER CONC. BY FIRE ASSAY - GOLD
SAMPLE: 85-1

BARTLETT'S TEST FOR HOMOGENEITY OF LABORATORY VARIANCE

CALCULATED STATISTIC	38.660
CHI-SQUARE(.95,19)	30.148

VARIANCE IS INHOMOGENEOUS

COCHRAN'S TEST FOR LABORATORY VARIANCE (ALPHA=.05)

NONE REJECTED

DIXON'S TEST FOR LABORATORY MEANS (ALPHA=.05)

NONE REJECTED

LIST OF LABORATORIES WHOSE RESULTS WERE NOT USED FOR ONE-WAY ANOVA

ALL RESULTS WERE USED EXCEPT INDIVIDUAL REPLICATES LISTED BELOW

LIST OF INDIVIDUAL OUTLIERS DETECTED BY DIXON'S TEST WITHIN-LABORATORIES

NONE REJECTED

ISO/TC 183/WG 1A/WG 1A-3 AU AND AG IN COPPER CONC. BY FIRE ASSAY - GOLD
SAMPLE: 85-1

ONE-WAY ANALYSIS OF VARIANCE TABLE

SOURCE OF VARIATION	D.F.	SUM OF SQUARES	MEAN SQUARE
BETWEEN LABS	19	.25499240E+02	.13420653E+01
WITHIN LABS	40	.12669333E+02	.31673333E+00
TOTAL	59	.38168573E+02	

REPEATABILITY VARIANCE	.31673333E+00
REPEATABILITY STD. DEV.	.56279067
BETWEEN-LABORATORIES VARIANCE	.34177731E+00
BETWEEN-LABORATORIES STD. DEV.	.58461723
REPEATABILITY	1.59269758
PERMISSIBLE TOLERANCE BETWEEN LABS	2.00140028
GRAND MEAN	31.37733333
VARIANCE OF THE GRAND MEAN	.22367754E-01

ISO/TC 183/WG 1A/WG 1A-3 AU AND AG IN COPPER CONC. BY FIRE ASSAY - GOLD
SAMPLE: 85-2

LABORATORY NO.	COUNTRY	BOTTLE NO.	ANALYTICAL RESULTS GOLD			LAB MEAN	LAB VARIANCE
1	LAB29	1	10.8900	10.9600	11.1700	11.00667	.2123E-01
2	LAB32	1	10.6700	10.8400	10.9200	10.81000	.1630E-01
3	LAB12	1	11.1700	11.7700	10.9300	11.29000	.1872E+00
4	LAB13	1	9.7700	10.2200	10.2600	10.08333	.7403E-01
5	LAB24	1	11.4100	11.0000	11.0900	11.16667	.4643E-01
6	LAB25	1	10.9700	11.3400	11.2400	11.18333	.3663E-01
7	LAB26	1	10.8000	10.8000	11.1000	10.90000	.3000E-01
8	LAB27	1	11.2800	11.6000	11.2900	11.39000	.3310E-01
9	LAB41	1	11.5500	11.8000	11.6000	11.65000	.1750E-01
10	LAB14	1	11.6100	11.4000	11.3300	11.44667	.2123E-01
11	LAB30	1	11.5000	10.9300	11.4600	11.29667	.1012E+00
12	LAB17	1	10.9000	11.8300	11.7600	11.49667	.2682E+00
13	LAB 1	1	11.7900	11.6800	11.7300	11.73333	.3033E-02
14	LAB 2	1	11.1300	12.8100	11.4600	11.80000	.7923E+00
15	LAB 3	1	11.1100	11.1700	11.1100	11.13000	.1200E-02
16	LAB 4	1	11.4300	11.0100	11.0600	11.16667	.5263E-01
17	LAB 7	1	11.6100	11.4100	11.6800	11.56667	.1963E-01
18	LAB 8	1	11.9600	11.8200	11.1200	11.63333	.2025E+00
19	LAB 9	1	10.0000	12.1300	10.9100	11.01333	.1142E+01
20	LAB10	1	11.0000	11.2000	11.3000	11.16667	.2333E-01

ISO/TC 183/WG 1A/WG 1A-3 AU AND AG IN COPPER CONC. BY FIRE ASSAY - GOLD
SAMPLE: 85-2

BARTLETT'S TEST FOR HOMOGENEITY OF LABORATORY VARIANCE

CALCULATED STATISTIC	41.779
CHI-SQUARE(.95,19)	30.148

VARIANCE IS INHOMOGENEOUS

COCHRAN'S TEST FOR LABORATORY VARIANCE (ALPHA=.05)

LAB 9	C-CALC = .370	C-CRIT(3,20) =	.270
LAB 2	C-CALC = .407	C-CRIT(3,19) =	.281

DIXON'S TEST FOR LABORATORY MEANS (ALPHA=.05)

LAB13	R = .521	D-CRIT(20) =	.488

LIST OF LABORATORIES WHOSE RESULTS WERE NOT USED FOR ONE-WAY ANOVA

LAB13	DIXON'S TEST FOR LABORATORY MEANS
LAB 2	COCHRAN'S TEST FOR LABORATORY VARIANCE
LAB 9	COCHRAN'S TEST FOR LABORATORY VARIANCE

LIST OF INDIVIDUAL OUTLIERS DETECTED BY DIXON'S TEST WITHIN-LABORATORIES

NONE REJECTED

ISO/TC 183/WG 1A/WG 1A-3 AU AND AG IN COPPER CONC. BY FIRE ASSAY - GOLD
SAMPLE: 85-2

ONE-WAY ANALYSIS OF VARIANCE TABLE

SOURCE OF VARIATION	D.F.	SUM OF SQUARES	MEAN SQUARE
BETWEEN LABS	16	.34278824E+01	.21424265E+00
WITHIN LABS	34	.21629333E+01	.63615686E-01
TOTAL	50	.55908157E+01	

REPEATABILITY VARIANCE	.63615686E-01
REPEATABILITY STD. DEV.	.25222150
BETWEEN-LABORATORIES VARIANCE	.50208987E-01
BETWEEN-LABORATORIES STD. DEV.	.22407362
REPEATABILITY	.71378685
PERMISSIBLE TOLERANCE BETWEEN LABS	.81047183
GRAND MEAN	11.29607843
VARIANCE OF THE GRAND MEAN	.42008362E-02

ISO/TC 183/WG 1A/WG 1A-3 AU AND AG IN COPPER CONC. BY FIRE ASSAY - GOLD
SAMPLE: 85-3

LABORATORY NO.	COUNTRY	BOTTLE NO.	ANALYTICAL RESULTS GOLD			LAB MEAN	LAB VARIANCE
1	LAB29	1	77.3900	77.2600	77.2600	77.30333	.5633E-02
2	LAB32	1	76.1000	76.2100	76.2000	76.17000	.3700E-02
3	LAB12	1	76.6900	77.2700	76.7500	76.90333	.1017E+00
4	LAB13	1	76.3500	76.7200	77.6300	76.90000	.4339E+00
5	LAB24	1	76.3400	76.4900	78.4600	77.09667	.1400E+01
6	LAB25	1	77.5500	77.9400	76.5400	77.34333	.5220E+00
7	LAB26	1	77.3300	77.3900	77.5400	77.42000	.1170E-01
8	LAB27	1	78.7900	78.2100	77.9200	78.30667	.1962E+00
9	LAB41	1	78.0500	78.0900	78.1900	78.11000	.5200E-02
10	LAB14	1	77.9300	76.7300	76.3700	77.01000	.6672E+00
11	LAB30	1	82.2800	79.0900	76.2100	79.19333	.9219E+01
12	LAB17	1	76.7700	77.3900	76.6100	76.92333	.1697E+00
13	LAB 1	1	76.9500	76.6800	76.8200	76.81667	.1823E-01
14	LAB 2	1	77.4200	77.4200	77.0000	77.28000	.5880E-01
15	LAB 3	1	76.3400	77.4500	75.9500	76.58000	.6057E+00
16	LAB 4	1	78.1100	75.9300	76.1100	76.71667	.1464E+01
17	LAB 7	1	77.5000	76.5400	77.0500	77.03000	.2307E+00
18	LAB 8	1	75.6500	75.8100	75.3300	75.59667	.5973E-01
19	LAB 9	1	77.7400	76.3800	75.7300	76.61667	.1052E+01
20	LAB10	1	75.7000	76.1000	77.3000	76.36667	.6933E+00

ISO/TC 183/WG 1A/WG 1A-3 AU AND AG IN COPPER CONC. BY FIRE ASSAY - GOLD
SAMPLE: 85-3

BARTLETT'S TEST FOR HOMOGENEITY OF LABORATORY VARIANCE

CALCULATED STATISTIC	57.391
CHI-SQUARE(.95,19)	30.148

VARIANCE IS INHOMOGENEOUS

COCHRAN'S TEST FOR LABORATORY VARIANCE (ALPHA=.05)

LAB30 C-CALC = .545 C-CRIT(3,20) = .270

DIXON'S TEST FOR LABORATORY MEANS (ALPHA=.05)

NONE REJECTED

LIST OF LABORATORIES WHOSE RESULTS WERE NOT USED FOR ONE-WAY ANOVA

LAB30 COCHRAN'S TEST FOR LABORATORY VARIANCE

LIST OF INDIVIDUAL OUTLIERS DETECTED BY DIXON'S TEST WITHIN-LABORATORIES

NONE REJECTED

ISO/TC 183/WG 1A/WG 1A-3 AU AND AG IN COPPER CONC. BY FIRE ASSAY - GOLD
SAMPLE: 85-3

ONE-WAY ANALYSIS OF VARIANCE TABLE

SOURCE OF VARIATION	D.F.	SUM OF SQUARES	MEAN SQUARE
BETWEEN LABS	18	.20767898E+02	.11537721E+01
WITHIN LABS	38	.15398733E+02	.40522982E+00
TOTAL	56	.36166632E+02	

REPEATABILITY VARIANCE	.40522982E+00
REPEATABILITY STD. DEV.	.63657664
BETWEEN-LABORATORIES VARIANCE	.24951410E+00
BETWEEN-LABORATORIES STD. DEV.	.49951386
REPEATABILITY	1.80151190
PERMISSIBLE TOLERANCE BETWEEN LABS	1.90290726
GRAND MEAN	76.97315789
VARIANCE OF THE GRAND MEAN	.20241616E-01

ISO/TC 183/WG 1A/WG 1A-3 AU AND AG IN COPPER CONC. BY FIRE ASSAY - GOLD
SAMPLE: 85-4

LABORATORY NO.	COUNTRY	BOTTLE NO.	ANALYTICAL RESULTS GOLD			LAB MEAN	LAB VARIANCE
1	LAB29	1	.6500	.6500	.6500	.65000	.0000E+00
2	LAB32	1	1.3000	1.2100	1.3600	1.29000	.5700E-02
3	LAB12	1	.7600	.7900	.6700	.74000	.3900E-02
4	LAB13	1	.8100	.7700	.8200	.80000	.7000E-03
5	LAB24	1	.5300	.6300	.6100	.59000	.2800E-02
6	LAB25	1	.6600	.5800	.5800	.60667	.2133E-02
7	LAB26	1	.7500	.6000	.7500	.70000	.7500E-02
8	LAB27	1	.5900	.5300	.5900	.57000	.1200E-02
9	LAB41	1	.8500	.8500	.7500	.81667	.3333E-02
10	LAB14	1	.8500	.6200	.8100	.76000	.1510E-01
11	LAB30	1	1.2500	.3100	.7000	.75333	.2230E+00
12	LAB17	1	.8200	.5800	.6800	.69333	.1453E-01
13	LAB 1	1	.5800	.5800	.5700	.57667	.3333E-04
14	LAB 2	1	.8200	.7000	.5500	.69000	.1830E-01
15	LAB 3	1	.5000	.5500	.5500	.53333	.8333E-03
16	LAB 4	1	.9000	.9100	.8600	.89000	.7000E-03
17	LAB 7	1	.8300	.5800	.8800	.76333	.2583E-01
18	LAB 8	1	.3500	.3500	.6100	.43667	.2253E-01
19	LAB 9	1	1.2000	1.0500	.7500	1.00000	.5250E-01
20	LAB10	1	.6300	1.0400	1.1100	.92667	.6723E-01

ISO/TC 183/WG 1A/WG 1A-3 AU AND AG IN COPPER CONC. BY FIRE ASSAY - GOLD
SAMPLE: 85-4

BARTLETT'S TEST FOR HOMOGENEITY OF LABORATORY VARIANCE

CALCULATED STATISTIC	48.728
CHI-SQUARE(.95,18)	28.877

VARIANCE IS INHOMOGENEOUS

COCHRAN'S TEST FOR LABORATORY VARIANCE (ALPHA=.05)

LAB30 C-CALC = .477 C-CRIT(3,19) = .281

DIXON'S TEST FOR LABORATORY MEANS (ALPHA=.05)

LAB32 R = .505 D-CRIT(20) = .488

LIST OF LABORATORIES WHOSE RESULTS WERE NOT USED FOR ONE-WAY ANOVA

LAB32	DIXON'S TEST FOR LABORATORY MEANS
LAB30	COCHRAN'S TEST FOR LABORATORY VARIANCE

LIST OF INDIVIDUAL OUTLIERS DETECTED BY DIXON'S TEST WITHIN-LABORATORIES

NONE REJECTED

ISO/TC 183/WG 1A/WG 1A-3 AU AND AG IN COPPER CONC. BY FIRE ASSAY - GOLD
SAMPLE: 85-4

ONE-WAY ANALYSIS OF VARIANCE TABLE

SOURCE OF VARIATION	D.F.	SUM OF SQUARES	MEAN SQUARE
BETWEEN LABS	17	.10855426E+01	.63855447E-01
WITHIN LABS	36	.47833333E+00	.13287037E-01
TOTAL	53	.15638759E+01	

REPEATABILITY VARIANCE	.13287037E-01
REPEATABILITY STD. DEV.	.11526941
BETWEEN-LABORATORIES VARIANCE	.16856137E-01
BETWEEN-LABORATORIES STD. DEV.	.12983118
REPEATABILITY	.32621243
PERMISSIBLE TOLERANCE BETWEEN LABS	.43382760
GRAND MEAN	.70796296
VARIANCE OF THE GRAND MEAN	.11825083E-02

ISO/TC 183/WG 1A/WG 1A-3 AU AND AG IN COPPER CONC. BY FIRE ASSAY - GOLD
SAMPLE: 85-5

LABORATORY NO.	COUNTRY	BOTTLE NO.	ANALYTICAL RESULTS GOLD			LAB MEAN	LAB VARIANCE
1	LAB29	1	8.2800	8.2500	8.2900	8.27333	.4333E-03
2	LAB32	1	8.8200	8.8200	8.8200	8.82000	.0000E+00
3	LAB12	1	9.3100	8.5700	8.3200	8.73333	.2650E+00
4	LAB13	1	8.6300	8.2300	8.8100	8.55667	.8813E-01
5	LAB24	1	8.5100	8.7600	8.4000	8.55667	.3403E-01
6	LAB25	1	8.5900	8.5000	8.2900	8.46000	.2370E-01
7	LAB26	1	9.3000	9.2000	8.5500	9.01667	.1658E+00
8	LAB27	1	8.7700	8.9700	8.5500	8.76333	.4413E-01
9	LAB41	1	9.0800	8.9200	8.8300	8.94333	.1603E-01
10	LAB14	1	8.6900	8.9200	8.7700	8.79333	.1363E-01
11	LAB30	1	9.0600	8.9100	8.5900	8.85333	.5763E-01
12	LAB17	1	8.2500	8.6500	8.4700	8.45667	.4013E-01
13	LAB 1	1	8.8500	8.9600	8.8900	8.90000	.3100E-02
14	LAB 3	1	8.6000	8.2500	8.8400	8.56333	.8803E-01
15	LAB 4	1	8.4100	8.5200	8.9500	8.62667	.8143E-01
16	LAB 7	1	8.4700	8.1200		8.29500	.6125E-01
17	LAB 8	1	8.7200	8.8400	8.9000	8.82000	.8400E-02
18	LAB 9	1	8.9500	9.0000	8.7000	8.88333	.2583E-01
19	LAB10	1	8.7400	8.7400	8.9700	8.81667	.1763E-01

ISO/TC 183/WG 1A/WG 1A-3 AU AND AG IN COPPER CONC. BY FIRE ASSAY - GOLD
SAMPLE: 85-5

BARTLETT'S TEST FOR HOMOGENEITY OF LABORATORY VARIANCE

CALCULATED STATISTIC	21.254
CHI-SQUARE(.95,17)	27.593

VARIANCE IS HOMOGENEOUS
(COCHRAN'S TEST NOT PERFORMED)

DIXON'S TEST FOR LABORATORY MEANS (ALPHA=.05)

NONE REJECTED

LIST OF LABORATORIES WHOSE RESULTS WERE NOT USED FOR ONE-WAY ANOVA

ALL RESULTS WERE USED EXCEPT INDIVIDUAL REPLICATES LISTED BELOW

LIST OF INDIVIDUAL OUTLIERS DETECTED BY DIXON'S TEST WITHIN-LABORATORIES

NONE REJECTED

ISO/TC 183/WG 1A/WG 1A-3 AU AND AG IN COPPER CONC. BY FIRE ASSAY - GOLD
SAMPLE: 85-5

ONE-WAY ANALYSIS OF VARIANCE TABLE

SOURCE OF VARIATION	D.F.	SUM OF SQUARES	MEAN SQUARE
BETWEEN LABS	18	.23584381E+01	.13102434E+00
WITHIN LABS	37	.20075833E+01	.54259009E-01
TOTAL	55	.43660214E+01	

REPEATABILITY VARIANCE	.54259009E-01
REPEATABILITY STD. DEV.	.23293563
BETWEEN-LABORATORIES VARIANCE	.26053688E-01
BETWEEN-LABORATORIES STD. DEV.	.16141155
REPEATABILITY	.65920784
PERMISSIBLE TOLERANCE BETWEEN LABS	.65263992
GRAND MEAN	8.69821429
VARIANCE OF THE GRAND MEAN	.23480283E-02

ISO/TC 183/WG 1A/WG 1A-3 AU AND AG IN COPPER CONC. BY FIRE ASSAY - GOLD
SAMPLE: 85-11

LABORATORY NO.	COUNTRY	BOTTLE NO.	ANALYTICAL RESULTS GOLD			LAB MEAN	LAB VARIANCE
1	LAB29	1	.3400	.3400	.3600	.34667	.1333E-03
2	LAB12	1	.4300	.4600	.4100	.43333	.6333E-03
3	LAB13	1	.5900	.5500	.5000	.54667	.2033E-02
4	LAB24	1	.4000	.4400	.4600	.43333	.9333E-03
5	LAB25	1	.4400	.4800	.4000	.44000	.1600E-02
6	LAB26	1	.4500	.3000	.4000	.38333	.5833E-02
7	LAB27	1	.4300	.4300	.4100	.42333	.1333E-03
8	LAB41	1	.6500	.6000	.6500	.63333	.8333E-03
9	LAB14	1	.4200	.5000	.4600	.46000	.1600E-02
10	LAB30	1	.8900	.7300	.5300	.71667	.3253E-01
11	LAB17	1	.5000	.4600	.4500	.47000	.7000E-03
12	LAB 1	1	.4400	.4400	.4300	.43667	.3333E-04
13	LAB 3	1	.3500	.4000	.4000	.38333	.8333E-03
14	LAB 4	1	.4900	.5100	.5500	.51667	.9333E-03
15	LAB 7	1	.5500	.5800	.5400	.55667	.4333E-03
16	LAB 8	1	.5300	.4500	.5100	.49667	.1733E-02
17	LAB 9	1	.6500	.5500	.5500	.58333	.3333E-02
18	LAB10	1	.4600	.3900	.3600	.40333	.2633E-02

ISO/TC 183/WG 1A/WG 1A-3 AU AND AG IN COPPER CONC. BY FIRE ASSAY - GOLD
SAMPLE: 85-11

BARTLETT'S TEST FOR HOMOGENEITY OF LABORATORY VARIANCE

CALCULATED STATISTIC	35.176
CHI-SQUARE(.95,17)	27.593

VARIANCE IS INHOMOGENEOUS

COCHRAN'S TEST FOR LABORATORY VARIANCE (ALPHA=.05)

LAB30 C-CALC = .572 C-CRIT(3,18) = .293

DIXON'S TEST FOR LABORATORY MEANS (ALPHA=.05)

NONE REJECTED

LIST OF LABORATORIES WHOSE RESULTS WERE NOT USED FOR ONE-WAY ANOVA

LAB30 COCHRAN'S TEST FOR LABORATORY VARIANCE

LIST OF INDIVIDUAL OUTLIERS DETECTED BY DIXON'S TEST WITHIN-LABORATORIES

NONE REJECTED

ISO/TC 183/WG 1A/WG 1A-3 AU AND AG IN COPPER CONC. BY FIRE ASSAY - GOLD
SAMPLE: 85-11

ONE-WAY ANALYSIS OF VARIANCE TABLE

SOURCE OF VARIATION	D.F.	SUM OF SQUARES	MEAN SQUARE
BETWEEN LABS	16	.29203529E+00	.18252206E-01
WITHIN LABS	34	.48733333E-01	.14333333E-02
TOTAL	50	.34076863E+00	

REPEATABILITY VARIANCE	.14333333E-02
REPEATABILITY STD. DEV.	.03785939
BETWEEN-LABORATORIES VARIANCE	.56062908E-02
BETWEEN-LABORATORIES STD. DEV.	.07487517
REPEATABILITY	.10714207
PERMISSIBLE TOLERANCE BETWEEN LABS	.22503319
GRAND MEAN	.46745098
VARIANCE OF THE GRAND MEAN	.35788639E-03

ISO/TC183/WG1A
DETERMINATION OF GOLD AND SILVER IN COPPER CONCENTRATES
BY FIRE ASSAY METHOD
STATISTICAL EVALUATION OF INTERNATIONAL TEST DATA 1984-1986

APPENDIX A. Ag

DETAILED COMPUTATION OF ANALYTICAL DATA

SILVER

ISO/TC 183/WG 1A/WG 1A-3 AU AND AG IN COPPER CONC. BY FIRE ASSAY - SILVER
SAMPLE: 85-5

LABORATORY NO.	COUNTRY	BOTTLE NO.	ANALYTICAL RESULTS SILVER			LAB MEAN	LAB VARIANCE
1	LAB 1	1	27.5000	27.5000	27.1000	27.36667	.5333E-01
2	LAB 2	1	28.9000	28.0000	29.6000	28.83333	.6433E+00
3	LAB 3	1	48.7000			48.70000	.0000E+00
4	LAB 4	1	26.3000	26.9000	26.7000	26.63333	.9333E-01
5	LAB 7	1	29.1000	27.2000		28.15000	.1805E+01
6	LAB 8	1	23.1000	26.3000	27.8000	25.73333	.5763E+01
7	LAB 9	1	32.1000	30.7000	29.6000	30.80000	.1570E+01
8	LAB12	1	30.4000	32.2000	28.4000	30.33333	.3613E+01
9	LAB13	1	31.6000	30.6000	33.7000	31.96667	.2503E+01
10	LAB14	1	31.8000	30.2000	30.7000	30.90000	.6700E+00
11	LAB17	1	29.8000	28.2000	27.8000	28.60000	.1120E+01
12	LAB24	1	29.7000	29.8000	29.7000	29.73333	.3333E-02
13	LAB25	1	27.8000	27.6000	26.9000	27.43333	.2233E+00
14	LAB27	1	30.2000	30.3000	30.4000	30.30000	.1000E-01
15	LAB29	1	27.5000	27.3000	27.4000	27.40000	.1000E-01
16	LAB41	1	33.2000	33.2000	33.7000	33.36667	.8333E-01

ISO/TC 183/WG 1A/WG 1A-3 AU AND AG IN COPPER CONC. BY FIRE ASSAY - SILVER
SAMPLE: 85-5

BARTLETT'S TEST FOR HOMOGENEITY OF LABORATORY VARIANCE

CALCULATED STATISTIC	38.259
CHI-SQUARE(.95,14)	23.691

VARIANCE IS INHOMOGENEOUS

COCHRAN'S TEST FOR LABORATORY VARIANCE (ALPHA=.05)

NONE REJECTED

DIXON'S TEST FOR LABORATORY MEANS (ALPHA=.05)

NONE REJECTED

LIST OF LABORATORIES WHOSE RESULTS WERE NOT USED FOR ONE-WAY ANOVA

LAB 3 LABORATORY SUBMITTED ONLY ONE RESULT

LIST OF INDIVIDUAL OUTLIERS DETECTED BY DIXON'S TEST WITHIN-LABORATORIES

NONE REJECTED

ISO/TC 183/WG 1A/WG 1A-3 AU AND AG IN COPPER CONC. BY FIRE ASSAY - SILVER
SAMPLE: 85-5

ONE-WAY ANALYSIS OF VARIANCE TABLE

SOURCE OF VARIATION	D.F.	SUM OF SQUARES	MEAN SQUARE
BETWEEN LABS	14	.18840295E+03	.13457354E+02
WITHIN LABS	29	.34525000E+02	.11905172E+01
TOTAL	43	.22292795E+03	

REPEATABILITY VARIANCE	.11905172E+01
REPEATABILITY STD. DEV.	1.09110826
BETWEEN-LABORATORIES VARIANCE	.41840373E+01
BETWEEN-LABORATORIES STD. DEV.	2.04549195
REPEATABILITY	3.08783638
PERMISSIBLE TOLERANCE BETWEEN LABS	6.18683305
GRAND MEAN	29.19318182
VARIANCE OF THE GRAND MEAN	.30801013E+00

ISO/TC 183/WG 1A/WG 1A-3 AU AND AG IN COPPER CONC. BY FIRE ASSAY - SILVER
SAMPLE: 85-1

LABORATORY NO.	COUNTRY	BOTTLE NO.	ANALYTICAL RESULTS SILVER			LAB MEAN	LAB VARIANCE
1	LAB 1	1	75.2000	75.1000	74.6000	74.96667	.1033E+00
2	LAB 2	1	91.5000	84.5000	80.3000	85.43333	.3201E+02
3	LAB 3	1	86.5000	79.9000	77.4000	81.26667	.2210E+02
4	LAB 4	1	73.4000	76.6000	72.6000	74.20000	.4480E+01
5	LAB 7	1	78.2000	77.8000	77.0000	77.66667	.3733E+00
6	LAB 8	1	71.4000	71.1000	73.9000	72.13333	.2363E+01
7	LAB 9	1	75.9000	77.4000		76.65000	.1125E+01
8	LAB10	1	76.2000	78.2000		77.20000	.2000E+01
9	LAB12	1	74.5000	80.3000	79.2000	78.00000	.9490E+01
10	LAB13	1	79.4000	78.1000	79.7000	79.06667	.7233E+00
11	LAB14	1	81.6000	75.8000	76.8000	78.06667	.9613E+01
12	LAB17	1	74.8000	75.3000	74.4000	74.83333	.2033E+00
13	LAB24	1	76.4000	78.5000	77.1000	77.33333	.1143E+01
14	LAB25	1	78.5000	77.4000	76.8000	77.56667	.7433E+00
15	LAB27	1	81.0000	79.5000	79.5000	80.00000	.7500E+00
16	LAB29	1	74.5000	75.5000	75.6000	75.20000	.3700E+00
17	LAB41	1	77.4000	76.8000	77.8000	77.33333	.2533E+00

ISO/TC 183/WG 1A/WG 1A-3 AU AND AG IN COPPER CONC. BY FIRE ASSAY - SILVER
SAMPLE: 85-1

BARTLETT'S TEST FOR HOMOGENEITY OF LABORATORY VARIANCE

CALCULATED STATISTIC	35.265
CHI-SQUARE(.95,16)	26.301

VARIANCE IS INHOMOGENEOUS

COCHRAN'S TEST FOR LABORATORY VARIANCE (ALPHA=.05)

LAB 2	C-CALC = .364	C-CRIT(3,17) =	.305
LAB 3	C-CALC = .396	C-CRIT(3,16) =	.319

DIXON'S TEST FOR LABORATORY MEANS (ALPHA=.05)

NONE REJECTED

LIST OF LABORATORIES WHOSE RESULTS WERE NOT USED FOR ONE-WAY ANOVA

LAB 2	COCHRAN'S TEST FOR LABORATORY VARIANCE
LAB 3	COCHRAN'S TEST FOR LABORATORY VARIANCE

LIST OF INDIVIDUAL OUTLIERS DETECTED BY DIXON'S TEST WITHIN-LABORATORIES

NONE REJECTED

ISO/TC 183/WG 1A/WG 1A-3 AU AND AG IN COPPER CONC. BY FIRE ASSAY - SILVER
SAMPLE: 85-1

ONE-WAY ANALYSIS OF VARIANCE TABLE

SOURCE OF VARIATION	D.F.	SUM OF SQUARES	MEAN SQUARE
BETWEEN LABS	14	.17560570E+03	.12543264E+02
WITHIN LABS	28	.64345000E+02	.22980357E+01
TOTAL	42	.23995070E+03	

REPEATABILITY VARIANCE	.22980357E+01
REPEATABILITY STD. DEV.	1.51592734
BETWEEN-LABORATORIES VARIANCE	.35775102E+01
BETWEEN-LABORATORIES STD. DEV.	1.89143072
REPEATABILITY	4.29007439
PERMISSIBLE TOLERANCE BETWEEN LABS	6.15258402
GRAND MEAN	76.66976744
VARIANCE OF THE GRAND MEAN	.29529708E+00

ISO/TC 183/WG 1A/WG 1A-3 AU AND AG IN COPPER CONC. BY FIRE ASSAY - SILVER
SAMPLE: 85-4

LABORATORY NO.	COUNTRY	BOTTLE NO.	ANALYTICAL RESULTS SILVER			LAB MEAN	LAB VARIANCE
1	LAB 1	1	138.5000	138.5000	138.7000	138.56667	.1333E-01
2	LAB 2	1	141.3000	145.3000	144.1000	143.56667	.4213E+01
3	LAB 3	1	145.1000	137.8000	138.3000	140.40000	.1663E+02
4	LAB 4	1	138.8000	134.7000	136.0000	136.50000	.4390E+01
5	LAB 7	1	142.8000	131.6000	140.0000	138.13333	.3397E+02
6	LAB 8	1	128.6000	133.3000	130.7000	130.86667	.5543E+01
7	LAB 9	1	140.6000	129.5000	144.4000	138.16667	.5994E+02
8	LAB10	1	137.0000	138.0000	141.0000	138.66667	.4333E+01
9	LAB12	1	146.5000	148.8000	152.0000	149.10000	.7630E+01
10	LAB13	1	144.0000	142.9000	147.1000	144.66667	.4743E+01
11	LAB14	1	145.0000	149.1000	144.1000	146.06667	.7103E+01
12	LAB17	1	139.0000	138.6000	137.6000	138.40000	.5200E+00
13	LAB24	1	135.7000	136.5000	136.0000	136.06667	.1633E+00
14	LAB25	1	136.0000	136.3000	140.3000	137.53333	.5763E+01
15	LAB27	1	141.5000	142.3000	141.5000	141.76667	.2133E+00
16	LAB29	1	134.5000	135.0000	134.1000	134.53333	.2033E+00
17	LAB41	1	143.6000	144.8000	143.4000	143.93333	.5733E+00

ISO/TC 183/WG 1A/WG 1A-3 AU AND AG IN COPPER CONC. BY FIRE ASSAY - SILVER
SAMPLE: 85-4

BARTLETT'S TEST FOR HOMOGENEITY OF LABORATORY VARIANCE

CALCULATED STATISTIC	41.357
CHI-SQUARE(.95,16)	26.301

VARIANCE IS INHOMOGENEOUS

COCHRAN'S TEST FOR LABORATORY VARIANCE (ALPHA=.05)

LAB 9	C-CALC = .384	C-CRIT(3,17) =	.305
LAB 7	C-CALC = .354	C-CRIT(3,16) =	.319

DIXON'S TEST FOR LABORATORY MEANS (ALPHA=.05)

NONE REJECTED

LIST OF LABORATORIES WHOSE RESULTS WERE NOT USED FOR ONE-WAY ANOVA

LAB 7	COCHRAN'S TEST FOR LABORATORY VARIANCE
LAB 9	COCHRAN'S TEST FOR LABORATORY VARIANCE

LIST OF INDIVIDUAL OUTLIERS DETECTED BY DIXON'S TEST WITHIN-LABORATORIES

NONE REJECTED

ISO/TC 183/WG 1A/WG 1A-3 AU AND AG IN COPPER CONC. BY FIRE ASSAY - SILVER
SAMPLE: 85-4

ONE-WAY ANALYSIS OF VARIANCE TABLE

SOURCE OF VARIATION	D.F.	SUM OF SQUARES	MEAN SQUARE
BETWEEN LABS	14	.97901644E+03	.69929746E+02
WITHIN LABS	30	.12407333E+03	.41357778E+01
TOTAL	44	.11030898E+04	

REPEATABILITY VARIANCE	.41357778E+01
REPEATABILITY STD. DEV.	2.03366118
BETWEEN-LABORATORIES VARIANCE	.21931323E+02
BETWEEN-LABORATORIES STD. DEV.	4.68308902
REPEATABILITY	5.75526113
PERMISSIBLE TOLERANCE BETWEEN LABS	13.86388424
GRAND MEAN	140.04222222
VARIANCE OF THE GRAND MEAN	.15539944E+01

ISO/TC 183/WG 1A/WG 1A-3 AU AND AG IN COPPER CONC. BY FIRE ASSAY - SILVER
SAMPLE: 85-2

LABORATORY NO.	COUNTRY	BOTTLE NO.	ANALYTICAL RESULTS SILVER			LAB MEAN	LAB VARIANCE
1	LAB 1	1	175.8000	175.0000	174.9000	175.23333	.2433E+00
2	LAB 2	1	175.0000	182.7000	177.5000	178.40000	.1543E+02
3	LAB 3	1	182.3000	186.8000	186.9000	185.33333	.6903E+01
4	LAB 4	1	182.4000	178.0000	174.3000	178.23333	.1644E+02
5	LAB 7	1	184.3000	182.4000	181.6000	182.76667	.1923E+01
6	LAB 8	1	167.3000	156.4000	168.1000	163.93333	.4272E+02
7	LAB 9	1	182.6000	184.7000	186.8000	184.70000	.4410E+01
8	LAB10	1	175.0000	177.0000	179.0000	177.00000	.4000E+01
9	LAB12	1	188.5000	191.1000	187.5000	189.03333	.3453E+01
10	LAB13	1	179.4000	178.4000	185.2000	181.00000	.1348E+02
11	LAB14	1	172.5000	176.6000	197.8000	182.30000	.1844E+03
12	LAB17	1	177.4000	176.3000	176.7000	176.80000	.3100E+00
13	LAB24	1	178.1000	172.2000	182.3000	177.53333	.2574E+02
14	LAB25	1	181.5000	172.0000	182.1000	178.53333	.3210E+02
15	LAB27	1	179.2000	181.1000	179.1000	179.80000	.1270E+01
16	LAB29	1	175.2000	175.5000	174.8000	175.16667	.1233E+00
17	LAB41	1	183.0000	183.4000	184.5000	183.63333	.6033E+00

ISO/TC 183/WG 1A/WG 1A-3 AU AND AG IN COPPER CONC. BY FIRE ASSAY - SILVER
SAMPLE: 85-2

BARTLETT'S TEST FOR HOMOGENEITY OF LABORATORY VARIANCE

CALCULATED STATISTIC	44.223
CHI-SQUARE(.95,16)	26.301

VARIANCE IS INHOMOGENEOUS

COCHRAN'S TEST FOR LABORATORY VARIANCE (ALPHA=.05)

LAB14 C-CALC = .522 C-CRIT(3,17) = .305

DIXON'S TEST FOR LABORATORY MEANS (ALPHA=.05)

LAB 8 R = .544 D-CRIT(17) = .529

LIST OF LABORATORIES WHOSE RESULTS WERE NOT USED FOR ONE-WAY ANOVA

LAB 8 DIXON'S TEST FOR LABORATORY MEANS
LAB14 COCHRAN'S TEST FOR LABORATORY VARIANCE

LIST OF INDIVIDUAL OUTLIERS DETECTED BY DIXON'S TEST WITHIN-LABORATORIES

NONE REJECTED

ISO/TC 183/WG 1A/WG 1A-3 AU AND AG IN COPPER CONC. BY FIRE ASSAY - SILVER
SAMPLE: 85-2

ONE-WAY ANALYSIS OF VARIANCE TABLE

SOURCE OF VARIATION	D.F.	SUM OF SQUARES	MEAN SQUARE
BETWEEN LABS	14	.69780444E+03	.49843175E+02
WITHIN LABS	30	.25288000E+03	.84293333E+01
TOTAL	44	.95068444E+03	

REPEATABILITY VARIANCE	.84293333E+01
REPEATABILITY STD. DEV.	2.90333142
BETWEEN-LABORATORIES VARIANCE	.13804614E+02
BETWEEN-LABORATORIES STD. DEV.	3.71545606
REPEATABILITY	8.21642792
PERMISSIBLE TOLERANCE BETWEEN LABS	12.01310181
GRAND MEAN	180.21111111
VARIANCE OF THE GRAND MEAN	.11076261E+01

ISO/TC 183/WG 1A/WG 1A-3 AU AND AG IN COPPER CONC. BY FIRE ASSAY - SILVER
SAMPLE: 85-3

LABORATORY NO.	COUNTRY	BOTTLE NO.	ANALYTICAL RESULTS SILVER			LAB MEAN	LAB VARIANCE
1	LAB 1	1	552.2000	549.5000	552.4000	551.36667	.2623E+01
2	LAB 2	1	541.7000	536.7000	541.0000	539.80000	.7330E+01
3	LAB 3	1	547.5000	565.6000	570.9000	561.33333	.1505E+03
4	LAB 4	1	541.4000	541.4000	544.4000	542.40000	.3000E+01
5	LAB 7	1	548.4000	550.0000	547.4000	548.60000	.1720E+01
6	LAB 8	1	524.9000	540.0000	534.7000	533.20000	.5869E+02
7	LAB 9	1	554.8000	553.9000		554.35000	.4050E+00
8	LAB10	1	554.0000	556.0000	546.0000	552.00000	.2800E+02
9	LAB12	1	592.4000	586.8000	568.7000	582.63333	.1534E+03
10	LAB13	1	538.3000	544.0000	540.9000	541.06667	.8143E+01
11	LAB14	1	582.9000	578.6000	583.4000	581.63333	.6963E+01
12	LAB17	1	545.6000	551.7000	551.4000	549.56667	.1182E+02
13	LAB27	1	562.4000	559.9000	559.0000	560.43333	.3103E+01
14	LAB29	1	551.9000	561.6000	557.6000	557.03333	.2376E+02
15	LAB41	1	563.8000	563.4000	562.8000	563.33333	.2533E+00

ISO/TC 183/WG 1A/WG 1A-3 AU AND AG IN COPPER CONC. BY FIRE ASSAY - SILVER
SAMPLE: 85-3

BARTLETT'S TEST FOR HOMOGENEITY OF LABORATORY VARIANCE

CALCULATED STATISTIC	32.080
CHI-SQUARE(.95,14)	23.691

VARIANCE IS INHOMOGENEOUS

COCHRAN'S TEST FOR LABORATORY VARIANCE (ALPHA=.05)

NONE REJECTED

DIXON'S TEST FOR LABORATORY MEANS (ALPHA=.05)

NONE REJECTED

LIST OF LABORATORIES WHOSE RESULTS WERE NOT USED FOR ONE-WAY ANOVA

ALL RESULTS WERE USED EXCEPT INDIVIDUAL REPLICATES LISTED BELOW

LIST OF INDIVIDUAL OUTLIERS DETECTED BY DIXON'S TEST WITHIN-LABORATORIES

NONE REJECTED

ISO/TC 183/WG 1A/WG 1A-3 AU AND AG IN COPPER CONC. BY FIRE ASSAY - SILVER
SAMPLE: 85-3

ONE-WAY ANALYSIS OF VARIANCE TABLE

SOURCE OF VARIATION	D.F.	SUM OF SQUARES	MEAN SQUARE
BETWEEN LABS	14	.82974193E+04	.59267281E+03
WITHIN LABS	29	.91920500E+03	.31696724E+02
TOTAL	43	.92166243E+04	

REPEATABILITY VARIANCE	.31696724E+02
REPEATABILITY STD. DEV.	5.62998438
BETWEEN-LABORATORIES VARIANCE	.19134068E+03
BETWEEN-LABORATORIES STD. DEV.	13.83259484
REPEATABILITY	15.93285580
PERMISSIBLE TOLERANCE BETWEEN LABS	40.73519754
GRAND MEAN	554.58863636
VARIANCE OF THE GRAND MEAN	.13568670E+02

ISO/TC 183/WG 1A/WG 1A-3 AU AND AG IN COPPER CONC. BY FIRE ASSAY - SILVER
SAMPLE: 85-11

LABORATORY NO.	COUNTRY	BOTTLE NO.	ANALYTICAL RESULTS SILVER			LAB MEAN	LAB VARIANCE
1	LAB 1	1	1565.3000	1561.7000	1562.7000	1563.23333	.3453E+01
2	LAB 2	1	1568.2000	1508.9000	1526.9000	1534.66667	.92'4E+03
3	LAB 3	1	1581.3000	1571.7000	1554.0000	1569.00000	.1918E+03
4	LAB 4	1	1510.5000	1557.9000	1546.9000	1538.43333	.6155E+03
5	LAB 7	1	1536.7000	1539.0000	1536.6000	1537.43333	.1843E+01
6	LAB 8	1	1613.9000	1515.6000	1522.5000	1550.66667	.3011E+04
7	LAB 9	1	1529.7000	1552.9000	1537.7000	1540.10000	.1389E+03
8	LAB10	1	1542.0000	1552.0000	1561.0000	1551.66667	.9033E+02
9	LAB12	1	1599.7000	1616.8000	1580.3000	1598.93333	.3335E+03
10	LAB13	1	1576.0000	1603.0000	1604.0000	1594.33333	.2523E+03
11	LAB14	1	1562.8000	1627.3000	1563.7000	1584.60000	.1368E+04
12	LAB17	1	1508.8000	1538.9000	1544.5000	1530.73333	.3686E+03
13	LAB29	1	1585.2000	1582.2000	1585.2000	1584.20000	.3000E+01
14	LAB41	1	1590.1000	1590.9000	1593.0000	1591.33333	.2243E+01

ISO/TC 183/WG 1A/WG 1A-3 AU AND AG IN COPPER CONC. BY FIRE ASSAY - SILVER
SAMPLE: 85-11

BARTLETT'S TEST FOR HOMOGENEITY OF LABORATORY VARIANCE

CALCULATED STATISTIC	39.737
CHI-SQUARE(.95,13)	22.367

VARIANCE IS INHOMOGENEOUS

COCHRAN'S TEST FOR LABORATORY VARIANCE (ALPHA=.05)

LAB 8 C-CALC = .412 C-CRIT(3,14) = .352

DIXON'S TEST FOR LABORATORY MEANS (ALPHA=.05)

NONE REJECTED

LIST OF LABORATORIES WHOSE RESULTS WERE NOT USED FOR ONE-WAY ANOVA

LAB 8 COCHRAN'S TEST FOR LABORATORY VARIANCE

LIST OF INDIVIDUAL OUTLIERS DETECTED BY DIXON'S TEST WITHIN-LABORATORIES

NONE REJECTED

ISO/TC 183/WG 1A/WG 1A-3 AU AND AG IN COPPER CONC. BY FIRE ASSAY - SILVER
SAMPLE: 85-11

ONE-WAY ANALYSIS OF VARIANCE TABLE

SOURCE OF VARIATION	D.F.	SUM OF SQUARES	MEAN SQUARE
BETWEEN LABS	12	.23345254E+05	.19454379E+04
WITHIN LABS	26	.85870200E+04	.33027000E+03
TOTAL	38	.31932274E+05	

REPEATABILITY VARIANCE	.33027000E+03
REPEATABILITY STD. DEV.	18.17333211
BETWEEN-LABORATORIES VARIANCE	.53838929E+03
BETWEEN-LABORATORIES STD. DEV.	23.20321718
REPEATABILITY	51.43052987
PERMISSIBLE TOLERANCE BETWEEN LABS	75.06301132
GRAND MEAN	1562.97435897
VARIANCE OF THE GRAND MEAN	.49883022E+02